Bulletin 11 July, 1930

Georgia Commercial Forestry Conference

AUSPICES

Georgia Forestry Association
Savannah Chamber of Commerce

WITH THE ASSISTANCE OF THE

Chamber of Commerce of the United States

SAVANNAH, MAY 26, 27, 28, 1930

PROTECTION
CONSERVATION
PERPETUATION
GEORGIA
FOREST SERVICE

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INTRODUCTION

The Georgia Commercial Forestry Conference, held at the Hotel DeSoto, Savannah, May 26, 27 and 28 under the auspices of the Georgia Forestry Association and the Savannah Chamber of Commerce, with the assistance of the Chamber of Commerce of the United States, is considered to be the most important meeting held in Georgia to discuss the problems of developing the forest resources of the state. Eminent authorities on various phases of forestry and forest products made such notable contributions to the conference that it is considered very important that the addresses be given wide circulation in bulletin form.

The Georgia Forestry Association which held its annual sessions before and after the conference program is the organization through which the conference was initiated. President T. G. Woolford of the association was chairman of the General Committee created to direct the forestry conference and is due much credit for the success attained, and Bonnell H. Stone, secretary of the association, also rendered able assistance.

The Chamber of Commerce of the United States, through Mr. W. DuBose Brookings and Mr. Alfred A. Doppel, rendered valuable service, not only in inspiring the conference but in assisting to develop the program.

H. L. Kayton, Chairman of the Executive Committee of Savannah, and the president and secretary of the Savannah Chamber of Commerce and the Convention Bureau, very materially contributed to the success of the conference and added to the reputation of Savannah as a city where conventions are treated with great hospitality and consideration.

One of the features of the conference was the exhibits designed to portray the work being done in forestry in the state and to show old and new uses to which forests are being put. The exhibits were collected by the Georgia Forest Service and consisted of a number of panels displaying its work also a number of appropriate exhibits of the United States Forest Service and exhibits of the American Forestry Association, Carson Naval Stores Company, the Rayon Institute of America, the Hercules Powder Company, Masonite Corporation, the Chamber of Commerce of the United States and the Caterpillar Tractor Company which also exhibited moving pictures.

The opening session of the conference, Tuesday, May 27, was presided over by T. G. Woolford, Atlanta, who said that the conference was being held to consider the problems of development of the state's great natural and potential forest resources.

The afternoon session of Tuesday was presided over by Hon. P. A. Stovall of Savannah. Hon. W. T. Anderson, editor of the Macon

Telegraph, presided Wednesday morning, and Hon. George Reynolds, Albany, Wednesday afternoon. The presiding officers added much to the interest of the meeting by their wise comments and suggestions.

The banquet tendered by the Savannah Chamber of Commerce on Tuesday evening with Colonel E. George Butler, president of the Savannah Chamber of Commerce, as toastmaster, and General Lytle Brown, chief engineer of the United States Army, and Mr. W. M. Wiley, director of the Chamber of Commerce of the United States as chief speakers, was a brilliant contribution to the program of the conference.

Appropriate resolutions were passed at the close of the conference which will be found summarized in the latter part of this bulletin.

The Georgia Forestry Association and the Georgia Forest Service are cooperating in having this bulletin printed for distribution. Conference addresses were prepared in manuscript form in most cases, the chief exceptions being some short, informal remarks of representatives of various chambers of commerce. No preparations were made to report these talks and it is, therefore, regretted that they are not available for this publication.

GEORGIA FOREST SERVICE.

SOME NOTABLE STATEMENTS AT GEORGIA COMMERCIAL FORESTRY CONFERENCE

"Experiments have demonstrated that these all-sapwood pines (longleaf and slash up to about 25 years of age) prior to scarification for oleoresin production contain but little physiological resin. The actual crop of oleoresin is a pathological product. The question of resin removal therefore no longer exists and the field is open for manufacture of all grades of paper by any process."—*CHARLES H. HERTY, Chemist, New York City.*

"All factors considered, no other equal area in the world can compare with the South as a potential source of an everlasting supply of wood pulp."—*RICHARD WOODS EDMONDS, Manufacturer's Record, Baltimore, Md.*

"The business of lumbering, turpentining and other forest uses represent large outlays in wages among local people. Unlike many other lines, the proceeds of the forests stay with us."—*GEORGE REYNOLDS, Albany, Ga.*

"Does the South want to build itself up to a great forest-producing region? It is easy for it to do so. The public must become forestry minded. The public must assist in fire prevention. The public must insist that timber land owners organize in timber protective units and that the state and the government provide adequate fire protection funds. If these things are done the economic prosperity of the South in the future is assured."—*CHARLES LATHROP PACK, President, American Tree Association, Washington, D. C.*

"Georgia is capable of producing $150,000,000 annually from its forest and potential forest area. ***** Under the Georgia forest fire protection system an annual outlay of $1.00 is preventing $2,500 damage."—*B. M. LUFBURROW, State Forester, Atlanta, Ga.*

"The region from Savannah west and southwest for about 150 miles has for some years been recognized as one of the most promising regions in the whole United States from the timber production standpoint. Strategic location is evident for one thing. A climate

and great areas of soil that favor rapid growth, with tree species among the most valuable are other factors."—*DR. AUSTIN CARY, United States Forest Service, Washington, D. C.*

"Imagine a field for conservative investment which definitely can be called better than insurance, safer than bonds, and more profitable than preferred stock. An economic situation now exists in the South that permits these specifications to be filled.***I know that you can find out for yourself that raising slash pine trees is safe, sound and profitable commercial enterprise."—***ALEX K. SESSOMS, Cogdell, Ga.*

"It seems to me we are now in a period of transition (in the naval stores industry) and that what we have learned is merely the opening chapter of the book and there lies before us a field of wonderful possibilities which in time we shall surely attain."—*H. L. KAYTON, President, Carson Naval Stores Company, Savannah, Ga.*

"The railroads are interested in forestry, not only as a carrier and purchaser of forest products, but because proper conservation, protection and handling of timber resources promise enhanced prosperity for the people of the state."—*A. E. CLIFT, President, Central of Georgia Railway Company, Savannah, Ga.*

"There is no greater field for true research than right here in our pine belt in Georgia *** We must place ourselves in a position to produce more efficiently and cheaply and through research develop our forestry products to a point where our products will have more value through diversification."—***A. S. KLOSS, Brunswick, Ga.*

"The South is in a position to assume leadership in forestry. It is not so much a task as an opportunity."—*F. M. OLIVER, Savannah, Ga.*

"Four years of protection have brought about in the way of increased growth of standing timber, increased naval stores per acre, increased stocking per acre of young growth. I can show you for one thing areas totalling by conservative estimates more than 70,000

acres which five years ago our cruise showed to be only 35 per cent stocked which can now be classified as from 90 to 100 per cent stocked."—*CAPTAIN I. F. ELDREDGE, Forest Manager, Superior Pine Products Co., Fargo, Ga.*

"No better objective could be set for the activities of any chamber of commerce than that of forest protection in its trade territory." —*BONNELL H. STONE, Blairsville, Ga.*

"The newspapers are interested because in the forests are hiding the hope of the wealth of this section in future generations—and cheap supply of newsprint for their own increasing use."—*DAN G. BICKERS, Associate Editor, Savannah News, Savannah, Ga.*

"The chemist and the chemical engineer are the men who will open up to us the new markets which may be developed from the forest products *** If bonds for farm-crop lands are commercially sound, why may it not be possible to work out a plan of long-time financing for the development of these timber holdings?"**—*GEORGE M. ROMMEL, Industrial Commissioner, Savannah, Ga.*

"Selective cutting reduces costs, leaves the land in a productive condition, provides a method of making an operation permanent, and, if widely followed, should have a powerful influence in making forest practice more practical and more profitable."—*R. D. GARVER, United States Forest Products Laboratory, Madison, Wisconsin.*

"Agriculture in this section without the aid of forest products has not been self-sustaining *** The State of Georgia could pass no wiser law than to exempt from taxation lands growing timber, collecting revenue from a certain percentage of price received from the timber when it is harvested."**—*LEONARD ROUNTREE, Summit, Ga.*

"Reducing waste to a minimum, conservative chipping, elimination of low yielding faces, the number of crops (gum) will be reduced and the average crop yield will be raised. In this way the prob-

lem of getting higher returns from turpentine woods will be met."— *LENTHALL WYMAN, U. S. Southern Forest Experiment Station, Starke, Fla.*

"The Georgis Forest Service is motivated with the thought that state forest-parks as play grounds, recreational centers, breathing spots, will be the show windows of forestry."—*WILLIS B. POWELL, Indian Springs, Ga.*

"This remaining land (575,000,000 acres) is far more than we are likely to need to meet our probable requirements (agricultural) during the present century*** In our country there has occurred an ever increasing efficiency in agricultural production·*****Agriculture is suffering severely from overproduction."—***DR. L. C. GRAY, Bureau of Agricultural Economics, Washington, D. C.*

"A knowledge of the constituents of resin is needed.***The possibilities in this field are tremendous and very interesting to the speculative chemist with a vision of the future of chemical industry. In resin we have the largest supply of an available, cheap, organic acid that exists ready to be converted into industrial uses when we have developed the technical processes for it."—***DR. W. W. SKINNER, United States Department of Agriculture, Washington, D. C.*

OUTLOOK FOR PRACTICAL FORESTRY

GEORGE REYNOLDS, Albany, Ga.

Saw Mills Introduced Civilization Into Back Country of the South—Lumber Production Still Major Industry and Commercial Backbone of State—Reforestation of Idle Lands Practicable and Profitable—Good Roads to Center Production

The Outlook for Practical Forestry is the phase of the subject on which I have been asked to speak in connection with this Conference. In other words, I am requested to talk to you about the prospects for a profit in reforestation.

Profits in any enterprise depend upon the demand and supply. If I undertake to stick close to my phase of the subject, I must deal closely with these two principles.

When we consider profits we cold-blooded business men think of dollars and cents, but many people think of profit from the standpoint of how they can serve the public in general and do a service to humanity. If we consider the profits from this reforestation project, we must think of it from both angles. I am going to try to present to you each side of the subject, and in my feeble way attempt to convince you that both the supply and demand will meet in a happy way and make it profitable for every one to co-operate in this great movement.

To visualize the demand it is necessary to consider the importance of the commodity and how the country would progress without it. From the beginning of time, when Adam used fig leaves for clothing and Noah built the ark out of wood, the products of the forest have been used for comfort, health, and happiness of mankind; and the demand has increased with the progress of civilization.

It is now difficult to find an important industry that is not in some material way dependent upon the products of the forest. We might assume that science would find a way to dispense with the product of the forest, but scientists have not succeeded in doing so. This is illustrated by the fact that some of the countries of the world most advanced in scientific research are purchasing from this country and other countries lumber and various forest products regardless of cost.

Timber in abundance was placed on this continent by the Giver of every good and perfect gift to supply directly and indirectly much that is essential to the health, happiness and comfort of mankind; to furnish homes, shelter and food for wild and domestic animals; for the protection of human beings; to prevent erosion and floods; and to hold in reserve a moisture essential to the growing of cultivated crops.

This important and essential commodity given us by nature has been wasted, but it is not too late for us to stem the tide, redeem ourselves, obtain forgiveness for the past and place ourselves in the proper light in the eyes of God and future generations.

Carried Civilization Into Wilderness

There was an excuse for wasting timber in years gone by. When the original settlers located in the northeastern part of our country they found a fertile land covered by wonderful timber and a need for cleared lands to cultivate certain food crops. The excess timber at that time was really a liability to them.

The lumber business started in the north woods many years ago. It then came south through various stages and finally the cut-over lands and cleared lands connect with the Atlantic on the east and the Gulf on the south.

However, while this operation with its wasteful practices was in progress, tram roads were built, camps set up, and civilization was carried to the extreme sections of the country. The lumber jack worked hard and long hours and endured hardships, but he rendered a service in his crude and wasteful manner while laying a foundation for permanent railroads, schools, churches, and villages that grew into cities in the wake of his devastation.

The network of railroads in Georgia were very largely logging railroads. The locations of the various towns were certainly picked by the pioneers of the lumber industry.

The lumberjack, whom I represent, asks for no special consideration. Rather, we would apologize for our wasteful methods; but we remind you of these things to impress you with the fact that forest products have been the leading light in making our country what it is today. Railroads have been referred to as the great civilizing force of the past, and true they were, but forest products made railroads possible and profitable.

Magnitude of Timber Products

We, as a whole, do not value the forests while we are giving credit to other products less essential and more expensive to produce, with more hazards involved in the operation.

Lumber products, aside from naval stores and other assets of the forest, amount to about $45,000,000 per year in the State of Georgia. Cotton, the major crop, which is very expensive and often disastrous on account of the boll weevil, runs to about $92,000,000 per year. Please keep in mind that the $45,000,000 of receipts come from just what you might call the lumber industry. Now, consider further the fact that tobacco, wheat and corn all together are only about equal to the total proceeds of the lumber industry, and the fact that these crops involve a lot of fertilization and toil to make them produce what they do.

The annual cash to our state from forest products is equal to the value of all cattle, sheep and hogs in the state. These annually require attention and cost money to feed and grow; on the other hand, timber grows while we sleep, and it requires more than one year to produce livestock to a matured, salable condition.

Please consider the fact that the annual value of lumber products exceeds the total capital of all state and national banks in the State of Georgia. Each year the proceeds from the lumber industry, which is only a part of the timber resources, would place in the State of Georgia, a duplicate of each state and national bank, with equal capital and surplus. You will please keep in mind that this is

independent of the naval stores, pulp wood, etc., which have only partially been utilized in years gone by.

Another comparison may be found in taxes. We all feel the sting of taxes and do a lot of complaining about them. Aside from government tax, profit tax, and inheritance tax, just keep in mind the fact that about 40% of all our state and county taxes go to the support of schools, and the schools are certainly worthy of the cost; but the return to our state each year from lumber products is two ond one-half times the $17,357,000, which represents the cost of operating our public schools.

Forest Wealth Stays in Community

Eliminate from our section certain industries directly dependent upon products of the forest and the principal money, or cash, crop is gone. This is the backbone of the entire merchandising business of our section. It makes possible a livelihood from professions (medicine, law, and others).

A wholesale dry goods house doing a million dollar business annually would be looked upon as an asset to your city, but the major part of the proceeds of their sales are sent to foreign markets for the goods they sell and are collected far from our own people, many of whom are dependent upon their incomes from the forest.

A lumber manufacturing plant or a naval stores operation doing a million dollar annual business brings into our section, largely from outside trade, just that amount of money which is distributed among many people, the land or timber owner, local railroads, laboring people, etc. It benefits the merchants, professional men; in fact, every man, woman and child is benefiitted by this industry.

This is an asset that we can not avoid being benefitted by regardless of our own indifference. It can not be carted away over night; the proceeds stay with us.

This must conclude my remarks in regard to demand for the commodity. We will now consider the cost of production and price to be received for it.

Throughout the country there are thousands of acres of nude lands producing nothing. There is entirely too much cleared land. The pendulum has swung too far. Within my lifetime I have seen the changes. Formerly when one had a farm for sale the question was, how much cleared land? Now the question is, how much timbered land? So, it is a fact that at least some people realize the importance of timbered lands or lands that will grow timber.

Production Cost of Timber

The real cost or expense for growing timber should be practically nothing. This is an extravagant sounding statement but, in my opinion, true. Timber, as previously stated, will grow without cultivation, without mechanical fertilization, without pruning or attention, if we let nature take its course and keep fire out of it. It costs nothing to grow it, if every farmer of every reasonable acreage would set aside half of his lands for a timber crop. Records show that farmers of the least acreage are the most prosperous.

In this section too much land has been controlled by one landlord, too many individuals are living in town on the prospective re-

sults of the farm. In other words, there are too many "agriculturists," and you know what the definition of an "agriculturist" is.

In the language of one good editor of a Georgia paper: "What we need down here in this God blessed country is something that will wake us up, something that will make us go to work." We have already had the boll weevil and a number of other things that have given us trouble, but probably we need some additional reverses. We are afforded too many advantages in this section. We are not alert to the situation, and expect too much of nature. It is said that the very best gardeners come from the bleakest spots of Scotland, and the very poorest farmers are produced in territory in Spain where they have very rich soil.

I can consistently say that, in my opinion, many acres of land in this southeastern section, where timber will grow prolifically, should be protected for growing timber, and that in most cases each real farmer owns more land than he can cultivate efficiently, and he should turn over to the growing of timber a good portion of his holdings.

The "Agriculturists" are responsible for the wasted lands which we observe along the highways. They and the speculator are the ones who have made it possible and necessary for the long loan companies to own large acreage and hold mortgages against many other acres.

Who will redeem these lands? Who will place them on a profitable basis? Certainly, it must be the mortgage companies or firms or individuals who are in position to purchase stocks and bonds for a reasonable length of time for investment; and if they invest in this way, subject to the reforms and considerations that must come from the public through our county, state and national governments, they will reap direct benefits with dollars in the pockets of their dependents and, at the same time, serve civilization in general in a very material way.

It will not be necessary for our various departments of government (county, state, and national) to exempt or make very light the taxes on forest reservation lands for a long period of time. Neither will it be necessary for tax supported departments to spend their money and time encouraging individuals to become cognizant of the opportunity to profit by this enterprise, but temporarily it is necessary that not only county, state and federal governments lend their influences through organizations represented here, but make light, for the time being taxes, as well as afford cheap protection from fire and supposed sportsm enwho slaughter the wild game, which is one

These departmental representatives and the independently interested individuals here are essential to a culmination of an understanding that will place on a profitable basis this industry. I can not conscientiously say that forestry or reforestation will be profitable without it. We must take advantage of the help and advice from various departments of the federal government, and we must solicit the consideration of county authorities.

Low Taxes Desired

We must also co-operate with every movement to encourage low taxes on lands set aside for timber growing, with offers to protect lands from ravages of fires, for a more sensible utilization of the full product of the forests. All of these phases will be brought out

in this conference. I hope that during these discussions the fact will be impressed by the party handling the tax question, that reduced taxes on lands growing timber will be returned a hundred fold. It is not a case of charity or special consideration to individuals but an encouragement to produce a raw material that will bring industry and wealth to our section, that can and will develop more taxable property than the entire value of these lands.

Another essential to a proper encouragement to the producers of forest products in this section is a fatherly consideration on the part of the railroads to keep their freight rates from this attractive timber growing section to the markets on a fair and equitable basis with rates from other producing sections, particularly the western states. These rates are now unfair, but I have confidence in the business judgement of railroad officials and believe that this will be voluntarily taken care of.

The railroads and the national government are now alert to the fact that there are, according to expert advice, one hundred million acres in the south better suited for growing timber than anything else and that along the Atlantic and Gulf Coast territory there are over thirty million acres ideal for this purpose and can not be competed with anywhere in the world. The state and county governments through public sentiment are awakening to an interest. These lands will produce tonnage for railroads, taxes for states and counties, and wealth for the benefit of all citizens.

I would like to go into detail to explain my vision of the future marketing of forest products but must simply mention that within all reason the future harvesting of timber will be along different lines from those of the past. Wasteful practices will be eliminated because of new devices and new inventions.

Hard surfaced highways are extending into the byways, and light inexpensive logging machinery is now available. Tramroads and railroads for lumbering, turpentining, and marketing pulp wood are no longer necessary. The motor truck and good roads have replaced the tramroad, and motor trucks and light motor driven machinery have taken the place of an operator's steam engines, cars and expensive equipment of other kinds. This is not a detriment to the railroads but a help, because they have not made money on these short expensive hauls of raw materials to concentrating points except to make a profitable tonnage available for final shipment.

The future lumber mill, pulp and paper mill, veneer mill, naval stores plant, etc., will be located at a central point, and through these improvements timber that is ripe can be harvested and delivered to market cheaply without disturbing the youth of the forests.

My opinion and contention is that forestry offers an opportunity for a profitable enterprise, but it is essential that the suggestions made in this conference be given serious consideration because they are pertinent to this success. I have faith in the final outcome and am following thils course.

If you follow the recommendations coming from the governmental departments, from the press, and from others who are trying to show the way, your investments in this enterprise will bear fruit (from dollars in your pocket standpoint) and leave for your dependents a great heritage. You will be able to pass into old age feeling that you have done something to justify your existence and have profited materially and otherwise.

COMMUNITY INTEREST IN FORESTRY IN BRUNSWICK TERRITORY

By A. S. KLOSS, Brunswick, Ga.

County-Wide Educational Campaign—Naval Stores Progress—Poles, Piling, Crossties, Veneer Exports Grow—Research Must Precede Greatest Forest Resource Development

It is indeed a pleasure and an honor to have the privilege of appearing before this worthy association in behalf of the Brunswick Chamber of Commerce.

Without taking too much valuable time, I will try to give you a resume of what has been accomplished in Brunswick territory in 1929; what the outlook for 1930 appears to be; and also, perhaps, my personal viewpoint of problems confronting the forestry situation.

The year 1929 may well be recorded as a year of improved interest in forestry. Through the assistance and kindness of Mr. W. C. McCormick, Regional Director, American Forestry Association, cooperating with a local Brunswick industry, it was possible to have a most excellent educational program on Forestry during the past year. This program, conducted by Mr. C. B. Wilson, Unit Director, was far-reaching and came in direct contact with 3800 adults and children in Glynn county. This is mentioned as of primary importance because it will convey to you that the Brunswick community has a great deal of interest in these problems.

Also, you are, of course, aware that practical and conservative forestry practices are in use by Brunswick industries, and it will not be necessary to take your time to discuss the operations of the Satilla Forest, since I understand it will be discussed at another time at this meeting.

From a business standpoint the figures for 1929 indicate the importance of Brunswick in forestry products. Of the industries located in Brunswick, Naval Stores, in all probability, reaches more people and affects the community to the greatest extent; poles, piling, cross-ties, and such products are a close second; and lumber and lumber products, including veneer, come third.

Classifying the Naval Stores into gum producers and wood producers, we may state that for—

(a) Gum Naval Stores Industry there were approximately:

1. 80,000 units produced.
2. 2,250 crops worked (36 units per crop).
3. 22,500,000 faces worked.
4. 18,000,000 trees worked.
5. 1,000,000 acres of gum producing territory (22.5 faces per acre.)
6. 1,560 sq. miles worked.

If there are 17,000 square miles of plain land in Georgia, the above represents approximately 10% of these lands. It is also estimated by reliable authority that timber shows an increased value of

7-8% per year, and also that about 90% of available timber is now being worked for turpentine.

(b) Wood Naval Stores Industry.

There has been considerable progress made in the Wood Naval Stores Industry during the past year, particularly in research work, about which I will speak later. Production showed no increase in 1929 over 1928. There were utilized in Brunswick territory in 1929:

1. 181,602 tons of stump and down wood.
2. 45,400 units produced.
3. 51,900 acres worked (based on 3.5 tons per acre).

(c) While I do not have the figures showing total tons of timber products (poles, piling, etc.) leaving Brunswick, yet I do have a comparison which should, in a comparative measure, be indicative of the business conducted. For the Brunswick Harbor figures there are shown:

	TONS		
	Outgoing	In Transit	Total
1928	272,016	32,406	309,422 Tons
1929	258,602	51,815	310,417 Tons

A slight increase in activity is shown.

The above gives a rough idea of past performance. What about the present and future?

The present depression of commodity prices must have and has had its effect on forestry and Naval Stores products. As with other commodity prices, those of forestry products are low. Under these circumstances we naturally find curtailed operations, particularly in poles, logs, cross-ties and veneer packages. Also, with reduced commodity prices, we may and are experiencing lower prices for raw material obtained from the forest.

Since five months of 1930 have passed, it seems certain that the present year will not offer large returns in forestry, and in many cases, severe losses will probably occur.

The future outlook may be anyone's guess. It depends to a large extent on the ability of those engaged in the industry to accomplish further research work and to produce such commodities as will be certain of higher value per unit or acre worked. As I speak of research, we must appreciate the present trend of process development, the changes that are taking place in industry, the over-production of almost all types of commodities, and the relative desires of the consumer in respect to satisfying demand. Certainly there is no greater field for true research than right in our pine belt of Georgia.

It is with a great deal of satisfaction that I can bring to your attention methods of operation in the wood naval stores industry for production of stump and down wood. If we recall that less than three years ago, the removal of stumps from the ground was done with dynamite, you will readily appreciate the research which has been done in placing forty-ton stump pulling machines and auxiliary mechanical equipment for the replacement of the dynamite method. (At this point I would point out the reduction of fire risks and the making of fire breaks by these machines in the woods.)

The above illustration points to results along mechanical lines. There is a wider field, and an equally important one, in chemical development. The pulp and paper industry should find its way into

Georgia: research is being conducted in the gum turpentine industry; the wood naval stores industry has, for sometime, produced paler rosin grades and commercial abietic acid through its extensive and continuous research program; and other forestry industries are conducting studies that will prove valuable.

In a general way, I have given you an idea of Brunswick's interest in these problems.

My personal opinion is to the effect that we must place ourselves in a position to produce more efficiently and cheaply, and through research develop our forestry products to a point where our products will have more value through diversification. When this is done we will be in a better and sounder position than we are today.

SAVANNAH'S INTEREST IN FORESTRY PROBLEMS

By F. M. OLIVER, Savannah, Ga.

Forestry a Public Problem, Related to Rivers, Harbors, Erosion of Hills, Floods, Game, Public Health—Savannah Linked to Forests in Naval Stores and Lumber—Desirable for Paper Manufacture—South Must Take Lead in Forestry

No creation of God's inanimate Kingdom is more enshrined in sentiment and, at the same time, invested with more practical value than a tree.

In the past, most of the forest land was under private ownership and was stripped of its growth without thought of the future. All the valuable timber of a tract of land was cut and the slash that remained was burned and thus a forest was destroyed. Then the cutting was continued on a fresh tract.

The growth of new timber on these cut over lands brings to the forefront all the manifold problems of forestry. They are not private problems. They have to deal with farm and forest, soil and climate, man and beast. They are intimately related to the navigability of rivers and harbours, the flow of streams, the erosion of hillsides, the destruction of fertile bottom lands, the devastation of flood, the game and birds of the forests, the public health and national prosperity. They influence the life of cities, states and nations.

Savannah's Vital Interest In Forests

To some cities, community interest in forestry problems may be of minor significance; but to Savannah the resultant effect of these problems involves practically her whole existence. Savannah is known as the Forest City. Our children are taught to venerate the tree. Savannah more than any other city in the Southeast is affected in her community life by forestry problems which now await solution.

If Savannah's trade territory does not produce the corn and cotton, truck and forage, fruits and vegetables formerly produced, because of change in rainfall or the erosion of hillsides, or the destruction of fertile bottoms, then Savannah's railroads, her railroad employees, Savannah's ships, the men who work on her docks, are directly affected injuriously. If the forests cannot be restored and those remaining cannot be preserved, then her timber, lumber and naval stores industries will be no more.

Our people are engaged in the manufacture and sale of spirits, oils and rosins from wood and stumps, in the cutting and marketing of ties, the purchase and shipping of piling, in the exporting of logs, the creosoting of timber and the manufacture and sale of furniture, paints and varnishes. Furthermore, we have twenty-five wood-working plants with an invested capital of ten millions of dollars, employing nearly two thousand people with an annual payroll of a million and one-half dollars, consuming annually nearly two hundred million board feet of lumber and with an annual output valued at eight mil-

lions of dollars. The annual production of lumber, within a radius of seventy-five miles of Savannah is approximately three hundred million board feet.

Naval Stores Center

Savannah is the world's naval stores market. In Savannah are made daily the prices which are advertised by the Associated Press to all parts of the world. Ships which load in Savannah distribute naval stores products to all of the principal ports of the world. The naval stores trade in Savannah gives employment to a large part of our population, financiers, executives, clerks, common and skilled labor. The value of naval stores shipped from Savannah, both foreign and domestic, average sixteen to seventeen million dollars annually. Naval stores is one of the most important sources of revenue to the railroad lines which serve Savannah. Naval stores represents the greatest tonnage in our foreign exports and is second in valuation.

Another community interest which Savannah has, in naval stores is the significant fact that more than two thirds of all the rosin oil now used in the United States comes from Savannah factories.

A further community interest for Savannah is the fact that our city is logically the place for chemical manufacture in which naval stores are the raw material. Savannah has shipped spirits of turpentine abroad for years and years. We are happy that such is the case. We hope for this trade to continue and to increase. But we take no pride in the fact that last year nearly five million pounds of synthetic camphor were imported from Germany. It is a reflection upon our city that some of the very turpentine which we shipped to Germany should there be manufactured into synthetic camphor and sent back into this country for commercial purposes, such as celluloid manufacture. It is the old story of carrying coals to Newcastle.

Why should not Savannah have that industry here in our own midst, utilizing our own material and employing our own people.

Logical Place for Paper Manufacture

Savannah should be, and I predict, will be the manufacturing center for pulp and paper in these United States.

Dr. Charles H. Herty tells us that: "Georgia slash pine grows seven times quicker than Canadian Spruce, which is its closest competitor. A tree which takes fifty to sixty years to grow to a size in Canada for naval stores and paper pulp will grow the same size in eleven to twelve years in Georgia."

Georgians must have faith in themselves and in Georgia's resources. There are too many Georgians who are investing in foreign bonds, on paper mills, when they could use their money to construct and operate paper mills at home. It is praiseworthy to urge outside capital to come to Georgia. We need every dollar we may be able to induce to come to our State. But what right have we to ask outside capital to invest in our resources when we have not shown our willingness to make a like investment.

Savannah's Chamber of Commerce is now engaged in compiling figures which will show the tonnage of pulp wood now growing within a radius of two hundred miles of Savannah. It is estimated that the supply is sufficient to keep between twenty-five and fifty pulp

mills running constantly, and it is a significant fact that the reforestation of slash pine will be the main source of the supply of pulp wood. As the new growth of pulp wood is thinned out in order to insure the growth of trees which will produce both turpentine and lumber, the pulp wood which is otherwise destroyed in the thinning out process is the kind and quality of wood best suited for the manufacture of pulp and paper. That which would be a waste product in reforestation will become a by-product of immense value to the South.

Rich Returns in Prospect

Southern forestry promises rich returns. There is no field of conservation which holds out a greater hope of financial reward. One need not be over optomistic when he predicts that the day is dawning when destructive forest fires, wasteful lumbering and archaic methods of turpentining in the South will be things of an almost forgotten past.

Gone are the days of ruthless and even wanton destruction of timber. One need not be over optimistic in predicting that the day is near at hand when "Forest regeneration will be reflected in a permanent lumber industry, in more prosperous communities and in timber lands where the careful husbandry of the forester will balance tree growth with tree use."

Gone are the days of cheap stumpage. Fifty years ago long leaf yellow pine stumpage averaged 5c per thousand feet. Today the lowest stumpage price is $5.00 per thousand feet. More than 225,000,000 acres of Southern forest soil must be made to continue their important part in the prosperity of the South and the Nation. The migration of negroes to the North and East has left us with the additional acreage for reforestation. These lands when devoted to the production of the slash pine will produce a larger revenue than they did when devoted to the cultivation, half-heartedly, of corn and cotton. The same is true of those lands which are allowed to lie idle because of the boll weevil pest. If nature be allowed to take her course, assisted by intelligent human effort, merchantable trees of the more valuable species can be grown in shorter time than was required for the chance survivors of a century or two of burning, illustrated by the greater part of that which we are proud to call our virgin forests.

The South today is in a position to assume leadership in forestry. It is not so much a task as an opportunity. It will enable us to insure the perpetuation of wood—that most useful of all of nature's gifts to man. So long as the sun shines and the rains fall, so long as hope is the mainspring of human effort, the same wonderfully productive climate, the same deep, fertile soil which produced these forests of yore, will yield, when aided by intelligent methods of reforestation, a more rapid tree growth than was yielded in the days of the regretted past.

COMMUNITY INTEREST IN FORESTS

BONNELL H. STONE, Blairsville, Ga.

Mountain County With Major Resources Develops Community Spirit In Fire Protection, Good Roads, Recreation and Erosion Prevention

Community interest in Union county has no dividing line between town and county. The only town here is the county site, located 21 miles from the nearest railroad shipping point in another state. The local citizens have profited by a county-wide community spirit, and their cooperation in a good road organization dates back to 1915, while more recent efforts to develop this scenic and healthful section of Georgia are showing results through the Union County Chamber of Commerce. With no manufacturing interests of any kind, and with a very limited local market for farm crops, the coming of paved roads has stimulated the harvesting of forest products until the truck-loads of lumber, ties, poles, and logs that now go out to the railroad daily are in striking contrast to the few wagon loads of ties and tanbark that formerly reached their shipping point over tortuous miles of mountain mud. Even now, the removal of forest products is limited, in comparison with the volume of hardwoods on the mountain sides, but the fact that 90% of the area is in forest growth clearly shows that community interest should be most vitally concerned in forest protection.

A good record of forest fire prevention has been made through the cooperation of a large land owner and the local citizens for the past 15 years, for the community began to realize that its main stake for the future depended upon this essential thing. In former years, the old custom of burning the woods had resulted in great losses by fire annually and perhaps 75% to 90% of the forest area was burned each year, but community interest brought about the cooperative spirit which now maintains an average burned area of less than one-tenth of one per cent.

The importance of watershed protection can be illustrated to no better advantage than within the boundary lines of this one Georgia county. A perfect picture of the cause and effect of flood waters was drawn by nature only a few days ago in this county when bottom lands and roads were overflowed by a creek which flows out of a small group of mountains that had been burned over last month, while the streams in other sections of the county remained within their banks as a result of no forest fires at their headwaters, and the protracted season of rain clearly brought home to our local citizens this concrete example. Even the younger people of the county discuss the fact that prevention of forest fires on the mountain rim of the area prevent floods in the valleys, and older citizens tell our visitors how they remember when logs and tree tops were brought down the rivers when swollen torrents were the result of forest fires. The community appreciates the fact that we now have a better county to live in, and that the attractions of Notalee river valley have brought a colony of Atlanta people who have built summer cottages and who spend week ends at Notalee Orchards Club, of which Mr. T. G. Woolford is president. This group of Atlanta people is appreciated by

every citizen of Union county, and community interest makes them realize that no summer visitors or new settlers would be attracted to a fire-swept locality in the mountains where valley farms suffered from constant recurrence of floods.

In Union county the development of community interest in forestry has made it possible for timber land owners to protect their lands from fire at very low cost, and the reproduction of new growth has resulted in greater volume and better quality than could otherwise have been obtained. On the other hand, the results of this community interest in Union county, so widely manifested today, largely influenced the president of Pfister and Vogel Land Company in giving to the state a deed, under the Forestry Act of 1925, to 160 acres of their most valuable lands on the Appalachian Scenic Highway at Neel Gap, which is now in use as the first state forest-park in Georgia. Thousands of people visit this mountain beauty spot annually from all parts of the United States, as shown by the register kept at the ranger headquarters, while the picnic area and over-night camping places are being taken advantage of continuously by native Georgians and citizens of nearby communities across the Carolina line.

If outdoor recreation is to be made most attractive in the Georgia mountains, the local citizens have come to realize that forest fires must be stamped out. The progress being made along that line in Union county is most encouraging and, in contrast with the many who openly advocated burning the woods prior to 1915, today there is not one outspoken advocate of woods burning, and the fire this past spring was the first in four years. The grand jury promptly investigated and brought two indictments against the guilty party at our last April term of court. No better objective could be set for the activities of any chamber of commerce than that of forest protection in its trade area.

In order to have better returns in agriculture, the prepetuation of forest crops, and the many other beneficial results of fire prevention, the cost in Georgia is only 3½ cents per acre. What greater interests could a community have than in the basic forest industries? Other speakers at the conference will discuss the great opportunities in the proper handling of Georgia's "Acres of Diamonds", so aptly named in a recent editorial.

May we all leave this Conference with the determination that Georgia **shall solve** her idle land problem, **protect** her waterpowers, **develop** her agriculture and all forest products industries through adequate fire prevention and just forest taxation.

THE NEED FOR A STATE PROGRAM OF LAND UTILIZATION

By DR. L. C. GRAY, Chief, Division of Land Economics, Bureau of Agricultural Economics, Washington, D. C.

Land Classification Essential in Determining Public Forest Policy, Local, State or Nation—Georgia Undergoing Readjustment in Land Utilization With Much Idle Farm Land Available for Forests

According to the **laissez faire** doctrine of our forefathers, the proper use of land could be safely left to the private individual, whose self-interest was supposed to lead him to use the land in the most efficient manner, not only from the standpoint of private profit, but also from the point of view of public welfare. The main role of government was conceived to be to transfer public land into private ownership as rapidly as possible, and then to leave the individual free to use it according to his own devices· In the presentation of this paper some fifteen charts were shown, which served to illustrate and amplify a number of the points. Since a large proportion of the charts have not been officially released, it has not been feasible to reproduce them. We have followed this comfortable doctrine since the foundation of our government. That which provides the essential basis of our National life, not only in the present but also in the illimitable future, has come to be regarded as the object of private rights of disposition and use over which but little restraint can be exerted in the public interest.

The results of these policies and attitudes are now apparent in all parts of our country; the Nation's heritage of timber so largely used up that it is possible to foresee an acute shortage of commercial timber within a very few decades; in your own Southland the virtual exhaustion of the bulk of your commercial supply of timber probably little more than a decade away, if present tendencies continue; immense areas of cutover land which are growing up to brush and uneconomical types of timber, except where fire or the depredations of livestock make even this form of reforestation impossible; throughout this and other States millions of acres of agricultural soils so depleted in fertility that they are no longer capable of profitable cultivation; in many regions, extensive farm abandonment and tax delinquency, decaying rural communities, and local governments seriously embarrassed by declining revenues.

These widespread conditions should make it apparent, even to the most obstinate apostle of **laissez faire**, that we must begin to take thought, in the interest of the public welfare, regarding the utilization of our land resources.

Our traditional outlook has been one of expecting a virtually unlimited increase of population, and consequently the prospective use for agriculture of all the land physically capable of being so employed. This point of view has coincided with the natural inclinations of the real estate promoter and of local business interests.

There are many reasons, however, why we must modify this

traditional outlook if we are to make progress in the development of a rational program of land utilization.

The first important reason is the outlook for population increases. Restrictions of immigration, and a birthrate, which for various reasons, is declining much more rapidly than death rates, make it appear probable that we are approaching a stationary population, which, it is estimated, will be attained at a maximum of 145,000,000 to 175,000,000 people, assuming no drastic modification in immigration policy. Furthermore, a similar tendency is occurring in those parts of Europe which have always constituted the best market outlets for American exports of farm products. Apparently, a rapid decrease of birthrates is occurring wherever industrialization and urbanization have become prevalent.

Agricultural Requirements

We have a large amount of potential agricultural land not yet cultivated. Somewhat less than 400,000,000 acres are now employed for crops; there remain approximately 575,000,000 acres physically capable of being used for crops, though not now so employed. Most of this land either is of low quality or requires heavy expenditures for drainage, irrigation, clearing, or fertilization, in order to make it available for use. This remaining land, however, is far more than we are likely to need to meet our probable requirements during the present century.

A more important question, however, is the present condition and immediate outlook for American agriculture, which is suffering severely from overproduction. In the decade ending in 1919 there was a large expansion in our crop area in nearly all parts of the United States. Since the close of the World War this expansion has continued in many parts of the western half of the United States where conditions are suitable for the growing of grain and cotton in spite of the depression. This increase occurred not only between 1919 and the census of 1924, but also, according to our estimates, has continued since 1924.

This increase of crop acreage in spite of price depression represents a very significant tendency for agriculture to expand into semiarid areas where the land is sufficiently level for the use of the combine harvester, the tractor, and other kinds of labor-saving machinery. This expansion has been made possible also by the adoption of drouth resistant varieties of grain and cotton and the introduction of the grain sorghums, which provide forage crops adapted to semi-arid conditions. These developments make possible a very low cost of production for grain and cotton. The tendency toward expansion of agriculture into areas of semi-arid land have been manifested also in Canada, Australia, and Argentina. Large areas of land of this character in these countries and in the western part of the United States capable of being devoted to crop production have not yet been cultivated. There is an enormous potential area of grain land in Russia which can become a most significant factor in world production whenever political conditions and economic organization become favorable to effective production and marketing.

In our own country there has occurred an ever increasing efficiency in agricultural production, as for instance, through substitution of machinery for man and horse labor, shifts from low yielding

to high yielding kinds of varieties of crops, increased use of commercial fertilizers and fertilizing crops, adoption of more productive types of livestock, and employment of more efficient methods of feeding.

Along with these tendencies toward increased production there have occurred certain changes in demand conditions which have also operated to the disadvantage of agriculture. We are consuming much more sugar per capita (largely imported) and much less flour and cornmeal per capita than before the world war. The substitution of tractors and automobiles for horses has eliminated a large part of the demand for feed. That the decrease in horses and mules is likely to continue for a number of years is indicated by the small number of colts on farms. European demand for American cereals has decreased, due to the recovery of European agriculture from War conditions and the policies of a number of the European governments to promote greater self-sufficiency in food supply.

Dislocation of Agriculture in Georgia

The various conditions of production and demand which I have mentioned have notably reacted on the agriculture of the United States, and particularly on the agriculture of the Southeastern States. From 1919 to 1924 there was a very general decrease in the area of crop land in the eastern half of the United States, and the decrease was particularly serious in Georgia, and other Southeastern States. Corresponding to this tendency, there has been a decrease in farm population, also extremely serious in Georgia and other Southeastern States. The dislocation of agriculture in Georgia is indicated by a great decrease in the annual value of the cotton crop, which was especially noteworthy in the old plantation counties of middle Georgia, due entirely to decreased acreage and lower yields per acre. There has been some recovery since the low point in 1923, but the recovery is only a partial one. In 1919 the gross income from crops in Georgia, excluding seed and crop fed was estimated at $457,942,000; in 1928 the corresponding figure was $193,789,000. In 1919 gross income from livestock products was $91,302,000; in 1928, only $76,721,000. Thus, the gross income of Georgia agriculture decreased from $549,244,000 in 1919 to $270,510,000 in 1928.

Obviously these conditions suggest the existence of an important problem of readjustment in land utilization, a problem which Georgia has in common with a considerable proportion of the area east of the Appalachian mountains and south of the Corn Belt. Partly on account of earlier conditions of development and partly on account of the fact that much crop land has gone out of cultivation in the past decade, the percentage of the total land area used for crops is very small in a number of parts of the State, and a good deal of the land which is not incrops is reported idle. A great deal of land in Georgia is in farm woodlots, and during the period of depression very serious inroads have been made upon the timber by the farmers, who have resorted to this method of supplementing the scanty returns derived from growing crops. There are also considerable areas where the acreage of land in farms is not a large proportion of the total land area. These are regions of large timber holdings, which, as you all know, are beginning to present the serious problems that come with the passing of the timber and the increase in area of cut-over land.

Idle Land Problems

The conditions that have been described are not merely transitory tendencies. The cutting of the timber is a continuing and cumulative evil. A large proportion of the farm land in these older areas will likely remain uncultivated for many years, due partly to the increased competition of areas better adapted to modern methods of farming, but partly to depleted soil fertility, the elimination of the income hitherto available from woodlots, and particularly because higher standards of living and of wages have caused many farmers to become unwilling to continue working for the small returns which they formerly accepted as normal. A vast re-grouping of our rural population is also taking place, with reference to obtaining the advantages of good roads, better schools, electric power, telephones and other facilities of living.

The all-important question, of course, is, what are we going to do about it? You will probably become impatient with me if I suggest that the starting point of the solution is the making of an economic classification of the land. You will doubtless say, as practical people are likely to say, "Why start out by proposing investigation rather than action?" I maintain, however, that an economic classification of land appears to be prerequisite to constructive action in the areas where these problems are most acute.

Land Classification Survey

The primary objectives in land classification are: (1) to define the areas that should continue to be considered agricultural, including range grazing, where this appears desirable; (2) to determine what use can be made of the land which is concluded to be non-agricultural, land classification in this sense is not merely an inventory of physical resources, such as oil topographic, and timber surveys, although all of these provide an important foundation for economic classification; nor is it a mere mapping of present utilization of the various kinds of land, although a knowledge of existing forms and methods of use provides an important point of departure and frequent significant indications for subsequent conclusions. On the contrary, economic land classification is aimed at reaching conclusions as to the feasible continuous mode of use of each class of land during the next several decades. It involves taking account not only of the physical environment, but also of the economic conditions of utilization, including market outlets, transportation facilities and costs, and tax rates.

It is sometimes said that prediction as to future uses for so long a period is virtually impracticable because of unpredictable changes in technical methods and other factors. The same objection could be raised to the making of a long range plan for any great business; yet the most astute business leaders do not hesitate to spend money in order to chart the probable course of their business development, taking present conditions as a starting point, allowing for such probable future trends as may be foreseen, and then later modifying the blue-prints at those points where unforseen changes make it desirable. The annual gross production of Georgia farms and forests is probably between a third and a half billion dollars annually, not counting the value of the services and products of the more or

less dependent business, such as railways, processing plants, factories, wholesale and retail distributing agencies, financial and real estate interests. What great business of such magnitude would hesitate at attempting to make a carefully worked out plan for its future development?

What practical benefits would be derived from land classification?

In the first place, it provides a means of dealing fundamentally with the problem of farm relief. In areas where agriculture has suffered serious economic dislocation, as for instance, in the Piedmont areas of this and other Southeastern States, there are thousands of farmers and other landholders in a condition of economic suspense, many of them attempting to continue operations under physical and economic conditions well-nigh hopeless. The local outlook concerning basic economic trends is frequently so vague and uncertain that the futility of attempting to continue operations becomes apparent but slowly. In some cases the difficulty is not primarily one of physical handicaps but rather, one of inefficient farm organization. A far-reaching reorganization is requisite, sometimes beyond the managerial capacity and the available capital and credit of many of the present operators. A program of organization needs to be developed which may be gradually promoted by bankers, farmers' organizations, extension forces, and other public agencies.

Farmers incapable of fitting into a program of reorganized agriculture, and especially those occupying farms, which would be submarginal under any system of farm organization should in many cases, be encouraged and aided to engage in farming elsewhere or in other occupations.

In some cases, it would be good policy for the County or the State to facilitate the progress of abandonment by purchasing some of these submarginal farms; not merely as a means of acquiring land for reforestation, for larger woodland areas can generally be bought more cheaply, but partly as a means of reorganizing the economic and social life of impoverished areas and especially of economizing public expenditures by eliminating the burden of maintaining schools and roads in areas now sparsely settled and due sooner or later to be largely abandoned.

In the areas where economic conditions have become seriously dislocated, an economic blueprint would provide an extremely valuable basis for planning the future progress for schools, roads, and other public institutions. The way some local Governmental Units are "going it blind" in these regards, taking little account of the radically changed economic outlook, is little short of astounding.

Land classification provides also a basis for discouraging the occupation of areas for farming where the inevitable result is sure to be not only economic disappointment and loss to the individual settler, but also the compelling local governmental units to assume unnecessary burdens for supplying a sparse and scattering population with schools and roads. During the past ten years I have had opportunity to observe these tendencies in many parts of the United States, and am convinced that they result in an enormous wastage of private and public resources, not to speak of the human wastage and disappointment.

Finally, I believe, land classification is wellnigh essential to the effective definition of our public forest policy, local, state, or na-

tional. Public opinion is not likely to be moved to provide for an adequate program of reforestation until it is made clear not only how much such a program is needed, but how such land and what specific lands are available for the purpose.

The task of providing adequately for the forest needs of the future is one of enormous magnitude. Making due allowance for changing requirements for timber, it is clear that within the next few decades we shall experience an extreme scarcity.

If we refuse to permit the rapid exploitation of our National and State forests, the period of scarcity will appear earlier and will be less serious; if we do not succeed in preventing such exploitation, the period of scarcity will be somewhat postponed, but the degree of deprivation will be ultimately more extreme.

Although there are certain areas, such as the seaboard counties of Georgia where conditions would appear more than usually favorable to private reforestation, provided suitable conditions of fire protection and taxation shall be brought about, it is becoming more and more apparent that, in many parts of the United States, we cannot rely in any large measure on private enterprise to develop an adequate program of reforestation. The period of growth is too long, human life too short, fire and other hazards too great, and the accumulation of costs at compound interest too rapid. Modifications in tax rates and methods and improved fire protection may encourage private initiative here and there, particularly in growing timber for uses requiring short cycles, but we should not wait for private enterprises to solve the forest problem. At the meeting of the American Forestry Association at Minneapolis a few weeks ago, Governor Christenson, of Minnesota, declared that he had been compelled reluctantly to accept this conclusion. Of the 340,000,000 acres of woodland in private ownership, hardly more than 5 per cent is being operated with a view to sustain yield. Much larger areas, of course, are undergoing a measure of natural reforestation under various handicaps of fire, disease, grazing, and wasteful destruction of young timber but the rate of destruction in the Nation as a whole is probably several times the rate of growth.

Public reforestation is justified not only to provide a future supply of timber, but also for the many unmeasurable benefits, including flood control, prevention of erosion, the preservation of wild life, and recreational and scenic values. In a number of important countries of Europe where basic economic conditions are far more favorable to private reforestation than in the United States, a much larger proportion of the forest area is in public ownership than in this country.

Is the development of a program of land utilization, a State function or a Federal function? It is both; and a county function as well. State and local agencies are immediately concerned with promoting local economic stability with economizing the cost of local government, and with the development of farsighted plans for the provision of schools, roads, and other services. There are many advantages justifying the development of State and County forest holdings. The carrying out of a program of land utilization must

depend also largely on local public opinion and initiative. On the other hand, the Federal Government is also vitally interested in promoting a sound and prosperous agriculture, in an ample provision for future timber needs, and in the various other benefits derived from the maintenance of forest areas.

FOREST PROTECTION HAS PROVEN PROFITABLE

By B. M. LUFBURROW, State Forester, Atlanta, Ga.

Georgia's 23,750,000 Acres Capable of Making Steady Prosperity for Georgia With Annual Income of $150,000,000—Georgia System of Forest Protection Saves Loss of $2,500 for Every Dollar Spent, Costing Less Than 4 Cents Per Acre Annually—Accomplishments of Timber Growers Given—Forest Wealth Profitable to All Lines Of Industry, Business and Profession

Forest Area and Resources

Georgia has 23,750,000 acres of potential forest land that is so classed because the timber crop on this area will show a greater profit on the investment to the owners than any other use of this vast area. Land utilization should be based largely on profit to the owner, and every acre in Georgia should be at work producing that crop which will yield the highest returns—all of the many ramifications and complex angles of cost being considered in this computation. Georgia under such utilization would truly be an Empire State that would feel a steady pulse of prosperity regardless of stock markets, inflations, over production and other conditions which cause hard times.

The forest area represents 63% of the total land area of the State and, under present adverse conditions, their forest products rank third among Georgia's natural resources.

The present agricultural policy of fewer acres more intensively cultivated means a larger area of abandoned marginal land left to produce timber, thus adding materially to the already staggering burdens of insufficiently manned forestry departments.

Abandoned Land Increase

At the present writing, the 1930 census indicates that in Georgia the decrease in population will be confined, almost without exception, to the rural sections, indicating abandonment of farm lands and turning back to forests perhaps 6½ million acres of farm land that should be growing a timber crop. If this great forest resource of Georgia, capable of producing a total of over $150,000,000 annually were developed under adequate fire control and proper forest management, it would attract the lumberman, naval stores, the pulp and paper industry, the rayon, cellulose, automobile, furniture, box and crate industries that would mean progress and prosperity for Georgia.

Forest Fire Responsibility

The forest fire evil must be overcome before this can be accomplished. The responsibility rests upon the private owner first. He should carry 50% of the load. The State recognizes 25% and the

Federal Government 25%. Under the American form of government the private owner has inherent rights and liberties in managing his private affairs, but in order to enjoy these he has a direct responsibility to Mr. Public.

The basic principles of state-wide forest fire control require the owner to render both active and financial support before receiving public assistance. There are certain conditions for which the individual is not responsibile, such as customs that have been handed down for generations; the belief that forest fire destroys certain pestiferous insects; the carelessness and indifference of those who start fires; and the ignorance of those who don't know and don't care. Dealing with these constitutes a public responsibility or duty that cannot be passed to the owner.

How can these problems be handled? By direct cooperation between the owner, the State, and the Federal Government in organized group effort which recognizes a direct line of responsibility in proportion to returns. The State and Federal Government receive only indirect returns, whereas, the owner receives direct returns and therefore should assume direct responsibility.

Adequate fire control requires an intimate working knowledge of local people, their customs, habits, beliefs, viewpoints. This the leading citizens of a community have; therefore the groups or organized owners are well equipped to handle local problems with State and Federal backing.

How the Georgia Fire Control Plan Operates

In 1925, when the State Board of Forestry was organized, the forest fire control problem was recognized as a major activity. Various systems were studied, but it was felt that methods in use were not adequate for Georgia conditions. The principles outlined above became the policy of the Board and the cooperative work started under this plan. Cooperation was offered to the timberland owners representing 10,000 acres or more, they to form a Timber Protective Organization (now known as a "T. P. O.") by electing a President, Vice President and Secretary-Treasurer, each officer to serve without compensation, assuming responsibility for directing the work of the organization under the cooperative agreement with the Georgia Forest Service.

Every timberland owner who pays his pro rata per acre cost of protection is eligible for membership in an authorized unit, and has a vote in proportion to his acreage entered in the protective unit. All collections are made by the officers, and purchases are made and bills paid by the T. P. O. Books are kept subject to audit by State and Federal Forest Officers and quarterly statements of expenditures rendered. A refund of 50% has been made by State and Federal Government on all funds spent under the budget set up for the cooperative agreement.

Forest officers make frequent visit to the T. P. O.'s, assisting in each and every phase of the work, and have an intimate knowledge of what every T. P. O. is doing, their weakness and their strength.

Under this system each owner get the character of protection he wants. If he wants lookout towers, patrol, firebreaks, telephone connection and fire fighting equipment, his assessment covers the per acre cost of such facilities. When the unit is too small to justify the

tower system, he can get the patrol and firebreak form, and in some instances the patrol system only, for the State Board of Forestry believes that the system employed must fit each and every condition in Georgia and be available to the small owner as well as the large.

The results of the past five years work has fully justified the system now recognized and operating in other states.

Our records show that during the calendar year 1929 land owners representing more than 1½ million acres, cooperating under the Georgia plan, had only .007% of the protected areas to burn. In many cases the individual T. P. O., or owner, did not have a single fire. Comparing the organized effort with the large area unorganized and unprotected, we find at least 20% of the unprotected area burned, while only .007% of the protected area burned. Taking this as a basis, it is found that for every dollar the State Board of Forestry invested in fire control, they saved the State a $2,500 forest fire damage.

Fire protection has cost the organized land owners representing 1½ million acres less than 4 cents per acre per annum under the Georgia system.

Has grouped effort in fire control been a profitable investment for the organized owner? Mr. W. J. Mullis, Route 4, Waycross, began protection work some 22 years ago. He says: " . . . If I could have had the Forest Service aid thirty years ago that we now have in educating the people in conservation of the forests, I feel that we could have had a country, now in its childhood, coming to high standard of wealth that it enjoyed sixty years ago.

Mr. John J. Gillis of Soperton, Ga., secured results as follows: He says: "In 1927 I began protecting my timber by plowing firebreaks on about 5,000 acres . . . . Today I have firebreaks on 12,000 acres and have had no fires to date . . . . I now have a good, even stand of young timber that is growing very fast, and by keeping fires out this land has increased in value 100 per cent. When I began work in 1927 my land was worth about $15 per acre. Now I wouldn't sell for $30 per acre." The net returns to Mr. Gillis, according to the above results is $15 per acre in two years protection.

The experience of Mr. J. M. Dyal, of Baxley, practicing fire control on 19,000 acres, brings out a very important point in that his turpentine labor is very anxious to "keep fires out" of the woods. He says, "I have been trying to practice fire control on 19,000 acres of land in Appling County for the past four years . . . . I am working 18 crops of turpentine timber on this tract and find that it produces more gum with less dry faces and fewer dead leaves than if burned over each year. I expected to have a good deal of trouble getting my labor to work on rough woods on account of the danger from snakes, but as most of the men are working on a basis of so much per barrel of crude gum they are now anxious to keep the fire out of their crops on account of the greater yield." He expects to continue his organized effort.

All operators are anxious to reduce expenses and increase profits. Mr. H. M. Wilson, Vice-President of Baldwin-Lewis-Pace Company of Jacksonville, makes a real saving through his investment in organized protection, a part of raking and burning cost. He says, "In the fall of 1926, after looking over several tracts of flat woodsland that had been protected from fire for from two to four years, I became convinced that all that was needed to establish a second growth of slash

pine timber on our place near Stockton, Ga., was protection from fire. After consulting with my associates, we decided to place our tract of approximately 15,000 acres under fire protection. We immediately began construction of fire lines, and supplied ourselves with one-man water tanks, torches, etc., for fire fighting. We were working at that time 15 crops of faces on part of this tract and as we wanted to establish new growth on the land on which these faces were being worked, we decided to protect this land also and not rake the boxes at all.

We have not raked a tree for the past four winters and in that time we have had not more than 500 faces burned out of an average of 16 crops per year worked on the place. In this connection, we acknowledge with sincere appreciation the community cooperation we have enjoyed. The average cost of raking being $75.00 per crops, we saved approximately $4,800 during the four years, and the total cost of our reforestation work on the entire 15,000 acres, including tractor and thinning, has not exceeded $5,000 to date.

Other owners are securing similar results. The possible solution for wholesale woods burning in the naval stores belt lies in organized fire control, and will come when favorable local sentiment is built up through demonstration areas established by leaders of the community who have the vision and see the possibilities.

Another very interesting angle of forest fire control which reduces the cost as well as increases the profits, is brought out in the work of Mr. J. Henry Gaskins, of Nashville, Ga., on his 6,500 acre tract. He uses every one of his 125 tenants as fire fighters. Their contract calls for fire fighting duties. He says, "Every farmer I have is a fire fighter, and it takes organized help to stop fire. I have practically a full stand of slash timber on all my land from small ones in the grass to 20 feet high, and where there has been no burning (as most of mine has been protected) timber grows much better and is not stunted by fire. You cannot have first class young timber and burn the woods. Fire and timber don't go good together. Woods can be kept rough with proper care."

Fire control is necessary for capacity production. Capt. I. F. Eldredge, Forester for Superior Pine Products Company of Fargo, says, "If we can average over a period of ten years an annual loss of not to exceed five per cent of the area, we will consider our work very satisfactory. As a result of four years of fire protection, we have restocked with slash pine over 70,000 acres of cut-over land that previously was less than 25 per cent stocked with longleaf pine . . . . It is necessary that there be no idle acres of land; avery acre must bear as nearly 100 per cent of its tree-growing capacity as it can be made to do by good management and fire protection."

Many T. P. O. members have not had any fires. Mr. J. C. Dunn of Baxley says, "We operated our timberland in cooperation with the State Forester, in cooperation also with the local Timber Protective Organization. Firebreaks have been constructed, patrol work done, etc., in an effort to protect our trees and make conditions better to produce more on the same lands. Our experience has been satisfactory. We have not had any fires even though our lands are in an area that has been used to more or less regular burning."

Timberland owners in the hardwood section of Georgia find profit in protection work. Here's what Mr. J. M. Lindsey of Armuchee, Floyd County, Georgia, says: "In the year 1893 I bought 200 acres of

timberland covered with pine and hardwood near Armuchee, Georgia. I have practiced forestry after some fashion ever since I owned it. The tract cost me $40 at that time. I took 150,000 board feet off the tract, doing my own cutting, during the next three or four years. This was mostly a selection cutting. One instance of such a cutting was the price I was offered for one white oak tree taken off of the tract. I was offered $60 for this one tree. After ten years I sold the sawmill rights to an operator and made him cut to a diameter limit of 10 inches. The cut ran to 600,000 feet. This represents the second cut. Three years ago I sold the timber rights again and the operator cut 200,000 feet from the tract.

I have endeavored to keep fire out during my ownership of the land because I believe in timber protection in every way, and hope that with the cooperation of the Georgia Forest Service I can get better protection for my land in the future."

Shippen Hardwood Lumber Company, of Ellijay, protect virgin stand until second growth is established; then the cutting operation begins. Their policy is: "This company owns approximately 50,000 acres of forest land . . . . Practically all of this area is virgin forest and most of the timber is hardwood . . . . The present owners of this tract have this land under organized protection from forest fires in cooperation with the Georgia Forest Service . . . . The owners fully appreciate the value of fire protection and it is their hope that when the mature timber is removed that a second growth will have been established to take the place of the original stand."

The first forest management work in the South under a technically trained forester on a large scale was that of the Pfister & Vogel Land Company, of Blairsville, Ga., which began in 1913 on 65,000 acres. Their forester, Mr. B. H. Stone, of Blairsville, says: "The company employed a trained forester in 1913 and a definite policy of protection was established in 1915. A report made by timber cruisers has convinced the owners that 65 to 75 per cent of these land were being burned annually, so the first lookout towers and telephone patrol system of the South were constructed on these lands in 1915-16, rangers and patrolmen being employed to direct the tenant-fire wardens. A good tenant system was used instead of paid fire fighters, and free range privileges were included in other concessions in order to secure cooperation in the prevention of forest fires. As a result of these methods, the average burned area per year has been less than one-tenth of one per cent from 1915 to the present time (1930). The owners are satisfied with this work as a paying investment, and are convinced that values in new growth more than off-set the cost of protection and all carrying charges on the property."

Forest protection is necessary for maintaining an adequate and pure municipal water supply. The Chicopee Cotton Mills of Gainesville, Ga., are managed by E. A. McCormick, who says: "The Chicopee Manufacturing Corporation purchased a tract of 3,652 acres situated in Hall County, Georgia, three miles southwest of Gainesville. The tract was acquired by the Chicopee Mfg. Corp. to get sites for reservoirs for the water supply of the mill and mill village and to get control of the watershed draining into the reservoirs. The object in undertaking to practice forestry on the property is to protect the watershed from erosion, to secure a more regular stream flow, to create an attractive setting for the mill and village and to secure a maximum production of forest products. The area has been placed

under intensive fire protection. A full time forest and game warden has been employed and devotes his time to patrolling the area, and is responsible for protecting it from fire."

Our schools profit by organized fire control. Mr. Green of the famous Martha Berry Schools of Rome, which owns 15,000 acres of land, says in part: "In 1928 Berry Schools cooperated with the Georgia Forest Service in establishing a timber protective unit, thereby working out a better system of protection. A lookout tower has been erected on a high point within the school property which overlooks the entire area. Telephones connect it with all buildings. When a fire starts it is soon put out because every boy on the campus is subject to call, if necessary.

As a result of protection, much new growth has been started, the old timber has grown to a better advantage, reproduction is coming in as under-forest to older timber. The results of protection are apparent, and this a fine example to hundreds of boys and girls who are students at Berry."

Dalton believes in promoting forestry and in forest fire protection. The Mayor says: "Through the efforts of several of Dalton's leading citizens cooperating with the Georgia Forest Service, the town forest of Dalton, Georgia, was created. Some 30 acres of the city property was set aside for a town forest in 1929. This 30 acres is covered with a 100 per cent stand of 8 to 12 year old shortleaf and loblolly pine. This forest was established more for a demonstration of forest possibilities to the people of Dalton and Whitfield County than for its commercial possibilities. Efforts are being made to establish fire breaks and adequate protection from fire. A fire line on one side of the tract is being established the first year.

These few statements of organized land owners are typical of the owners of 1½ million acres cooperating with the Georgia Forest Service. In this connection, your attention is called to Bulletin No. 10, "Profitable Forestry in Georgia," which is now available for distribution here. It contains many records of profitable results from grouped effort in forest fire control.

Summing up, we find that "Forest Protection has Proven Profitable" to the State, the Federal Government, the county, the town, the small and large commercial forestry industries, the leather company, the cotton mill, colleges and schools, the turpentine operator, naval stores factors, the lumberman, large and small land owners, and the farmer, which in turn reflects through indirect influences on all phases of commerce and industry. It is for this reason that forestry merits and is receiving the support of these many and varied interests.

MESSAGE OF CHARLES LATHROP PACK, PRESIDENT OF AMERICAN TREE ASSOCIATION

Easy to Build Up South as Great Forest Producing Section and Assure South Economic Prosperity With Annual Forest Crop— Message Sent to Conference Through P. S. Ridsdale

"The South is awakening to the fact that it can be the future forestry storehouse of the nation, a storehouse teeming with all those products of the forest that keep the wheels of industry turning.

"Trees grow more rapidly in the South than anywhere else in the United States. The day of the big tree as a forest crop is rapidly passing for thousands of uses have now been found for the smaller sizes.

"The meat packers say they use every bit of the hog except the squeal. I say to you the day is not far distant when every bit of the tree will be used, including the bark.

"Science is making a wonderful stride forward in utilization of wood fibers. Soon will come the day when forest crops, only a comparatively few years old, will be marketed.

"The South has vast acreages of land most suitable for growing trees. It has the ability to protect those trees from fires while they are growing. All it needs for such protection is wide spread public cooperation, proper organization of timberland owners, plus adequate financial assistance by the states and the National Government.

"At one time there were 650,000,000,000 feet of pine timber in the South. Recent figures show there are now only 139,000,000,000 feet.

"Only about 20% of the virgin hardwood stand is left.

"Is it necessary to increase the present stands of softwood and of hardwoods in the South? Your foresters, and your timbermen, will tell you that it is. Your economists will tell you that the annual value of the naval stores products in the South per year is $30,000,000,00.

"Does the South want to build itself up as a great forest producing region? It is easy for it to do so. The public must become forestry minded. The public must assist in fire prevention. The public must insist that timberland owners organize in fire protecton units, and that the states and the government provide adequate fire protection funds.

"'If these things are done the economic prosperity of the South in the future is assured, for then the annual forest crop will be a financial crop, and public prosperity will prevail."

A NATIONAL PROGRAM FOR FORESTRY EDUCATION

P. S. RIDSDALE, American Tree Association, Washington, D. C.

Cooperative and Continuous Forestry Education of All Agencies Essential to Put Idle Lands to Work Growing Trees—News-papers Important Medium—Economic Independence Of Forest Products Possible

I have been assigned to speak on the subject of "A National Program for Forestry Education." There is no such program being carried on by any government agency, nor is there ever likely to be one. If anyone argues that the United States Forest Service should carry on such a program, the answer is that Congress would probably never appropriate a sufficiently large amount of money to make it possible to do so effectively. Nor can one hope that any state legislature will appropriate all that a state should have for a state forestry program of education. So, the so-called national program of forestry education must consist of the best the federal and state governments can do, supplemented by the work of numerous other agencies, and if this is kept up long enough this kind of education will produce good results. It is certain that if the thought of the nation can be united on any given economic problem a solution of that problem is in sight. For instance an interesting thing about the proposition of putting our hundred million acres of idle land to work growing trees is that no one, to whom you talk about the problem, is against it. All agree with you almost at once—and yet little is being done to put this idle land to work, because there is no insistent public demand for this most necessary planting.

A national program of forestry education must be carried on all the time. The American Tree Association under the leadership of Charles Lathrop Pack is directing its effort to that end. One of the important phases of this work has been the giving of three and a half million Forestry Primers to the schools of the country. Why? Because the pupils by reading and discussing the fifteen lessons the Primers contain acquire a knowledge of forest values—and these pupils—our coming citizens—will grow up forestry minded.

The forestry problem in this country will never be solved until the American people do become forestry minded. In the last analysis it is the great taxpaying public which must demand that our forest lands be made to produce an annual crop of forest products so that we will not have to import what we need from other countries.

Public education may be conducted in many ways but the chief of these is—and always will be—publication in the newspapers of facts about our forest conditions. The publisher himself is dependent directly upon pulpwood. Paper is the messenger of the greatest educational force we have; the printed word. Consequently the editor, that great force in making the nation forestry minded depends absolutely on trees for a living. Editors became forestry minded long ago.

Today more than half of the wood used for paper in the United States comes from outside our boundaries—chiefly from the spruce forests of Canada and even far off Russia is called upon· We must depend on foreign imports for millions of cords of wood and wood pulp. This is not through any failure of our own forests' ability to produce what we need for with our vast area of forest land we could grow annually more wood for paper than we shall need annually for many years. The great fertility of our forest soils should make cheap domestic sources of raw materials entirely practicable. So far we have made no serious effort to become self-supporting.

Yet the time is not far off when we shall have to adopt some nation-wide program for raising all the wood we need for paper making, or our industry will have to depend almost entirely on imports from foreign countries.

The enormous demand for paper which today consumes ten million cords of wood yearly is bound to increase. To offset this, it is of course quite possible that methods will be discovered for using other products than wood. But the main reliance for abundantly meeting our pulp wood requirements must be placed ultimately on the United States growing our paper producing species. Alaska, with her practically untouched forests, will supply two million cords annually or one-fifth of our present needs. And, since these forests are owned by the Government, they will be so cut that they can produce this amount year after year forever. But Alaska is a long way from our pulp and paper mills which, for the most part are clustered about the Atlantic seaboard.

This is only one great industry dependent upon forests. There are many others. You can apply a set of cost figures to a great many industries and you will find the basis of costs in forest products. It is all a question of plain economic sense. The center of the greatest forest resources is now in the far west and the great industries are away on this side of the continent. What army could last a week two thousand miles from the base of supplies? What industry operates without wood in some form? We must look to the future; get out of this age of forest neglect, put idle forest land to work on a wholesale scale, and adequately protect our forests from fire.

So it is we must have continuous forestry education to create a demand for a continuous forestry crop ample for our needs. Every opportunity must be taken to advance the proposition that national prosperity depends upon a steady flow of forest products to the great manufacturing centers. This is another way of saying idle land must be put to work growing forests. This message, along with fire prevention, must be carried home to all of our citizens all of the time.

SELECTIVE LOGGING AS A PROTECTIVE MEASURE

R. D. GARVER, Senior Forester, Forest Products Laboratory, United States Forest Service, Madison, Wisconsin

Southern Pines Cut Below 12 Inches in Diameter Are Unprofitable— Selective Cutting of 16-inch Timber and Over Admits of Permanent Operation and Frequent Cropping— Also Increases the Incentive for Fire Protection

Selective logging as here used does not mean a "creaming" of the stand to reap the highest present value without regard to the future, nor does it imply cutting to a rigid diameter limit, but it does mean a partial cutting practice which takes out enough trees, usually the larger sizes, to make logging profitable and yet leaves sufficient smaller thrifty ones to restock and keep the land productive. Such a method of cutting has a place in the proper handling of Georgia's 21 million acres of timberland and is discussed here as a protective measure from the standpoint of fire, community and industrial stabilization, soil erosion, and finally as a measure to bring about more efficient use of forest land.

Most people quite naturally wish to protect certain kinds of property, such as houses and automobiles, from fire, because they realize that there is a loss if such property is burned. But no such consciousness is universally present in people's minds when fires run through woods or sweep over clear cut land. On the other hand, if an area of planted trees is burned, nearly every one realizes the loss and appreciates the necessity for keeping fire out of such tracts. Is it not reasonable to expect the same reaction to fire protection for stands which have been logged only partially with the idea of allowing the small trees to remain on the ground and grow into a future cut? The logger's or owner's interest does not end with the last log removed from the land, for he has an investment that will increase in value in direct proportion to the protection and management he gives it. Waiving all other considerations, it seems almost certain that fire protection would be much better on large areas handled under a selective cutting system than on areas that were logged clean without a thought of a return cut. In addition, the fire hazard is less on selectively cut areas than on clear cut lands because there is less slash, the humidity of the air is higher, and the wind velocity is less. For example, in a hardwood forest in the Lake States[2] it was found that during the summer months the maximum temperatures were four to five degrees lower, the amount of moisture in the air 6 to 7 per cent higher, and the average wind velocity only one-fourth as much on forested areas as on clear cut areas.

It is not easy to create a protective interest in a cut-over burned-

[1]Maintained at Madison, Wis., in cooperation with the University of Wisconsin.

over country dotted with "ghost" towns, silent sawmills, grass covered railroad tracks, and boarded-up depots. Such a country may come back in time if a few seed trees have escaped and are protected from fire, but the reincarnation into a thriving, prosperous community lies a long way in the future and even if accomplished can never repay the social and financial losses incurred when the last log of virgin timber was cut and the industry moved on."

Such a prospect faced a community in the Lake States, but the Lumber company did not choose to follow such a course. A technical forester was called upon to prepare a program which would make it possible to keep the mill running for all time. The plan involved a slight reduction in the capacity of the mill, a small land purchasing program, and the introduction of selective logging into the woods operations. After careful consideration of all the facts the company adopted the plan. Fire protection is being tightened up and is taking on a new importance. The company is going ahead with an eye to the future and business and social developments are no longer based on the time when the mill will cut out, but are planned for all time. This change has been brought about because the lumber company decided to make its operation permanent and chose selective logging as the best method of handling its timber lands so that they would yield a crop of logs periodically. To make more certain that the full productivity of the land is obtained, a nursery has been established to supply stock for filling in on small cut-over areas where seed trees or a stand of young timber are lacking. Extremely close utilization is practiced. Cordwood, slabs, edgings, trimmings, and small unmerchantable logs supply the material for the alcohol plant. The high grade logs keep the veneer plant in raw material, and the sawmill cuts the medium grade logs into lumber." A forest properly handled not only contributes these various classes of raw material but at the time it offers resistance to soil erosion and gullying. In addition, forests actually build up the soil instead of running it down."

Protection Against Erosion

Over one-half Billion tons[3] of suspended matter is disgorged annually into the sea by the rivers of the United States and twice this amount is deposited along the water courses, on flood plains, and, last but not of least importance, in large reservoirs. Such a condition impoverishes the soil on the upper slopes without a compensating enrichment of the areas on which it is deposited, reduces the impounding capacity of storage reservoirs, changes stream courses, interferes with navigation, and on the whole does a large amount of damage. No one can gainsay that a vegetative cover reduces erosion and the gullying of the soil. If this cover, in addition to holding the soil, is growing a crop of salable and valuable material, such as lumber, so much the better. This is one of the main reasons why forests are of outstanding importance in the control of erosion and flood damage.

Soil conservation goes hand in hand with control of water move-

[2]U. S. Department of Agriculture Technical Bulletin 164, "Selective Logging in the Northern Hardwoods of the Lake States" by R. Zon and R. D. Garver.

[3]U. S. Department of Agriculture Circular 33 "Soil Erosion a National Menace" by H. H. Bennett and W. R. Chapline.

ments in and on the soil. These two factors together with climate pretty largely determine the extent to which a country dependent on soil crops for its prosperity can be developed. The importance of forests in checking erosion and reducing floods can not be overemphasized. The greatest efficiency will come when the forest and ground cover are kept fairly well intact. Moreover, this requirement is directly associated with methods of handling timberlands so as to get a profitable return and yet keep the land stocked with a growing crop.

Profitable Selective Cutting

There are several different ways of handling southern pine stands, such as clear cutting followed by planting or by leaving seed trees. Selective cutting, however, has several advantages not found in the other forms of management. This method takes out only a portion of the stand, mostly the larger mature trees, and leaves the smaller thrifty ones to restock the land and provide a future cut. Under such a plan it is possible to get a cut from the land at more frequent intervals than in the clear cutting or seed tree method and in addition a fairly good ground cover is maintained at all times. Furthermore, it costs less to handle large trees and the quality of lumber obtained from them is better than that from small trees. Before a selective logging plan for a tract of timber can be formulated, it is necessary to know something about the cost of producing lumber from trees of different sizes and the value of the product. Realizing this need the Forest Service has been carrying on studies to get just such information. Work has been done in the Coastal Plain and in the Gulf section of the southern pine region. In most cases it was found that trees too small to pay their way were being removed from the land. The actual costs and lumber values obtained in a band mill operation, which was cutting second-growth shortleaf and loblolly pine about 55 years old, will best illustrate this point.

Diameter of tree Inches	Production cost per M board feet	Value of lumber per M board feet	Difference
8	$32.11	$21.62	$—10.49
10	25.81	22.52	— 3.29
12	23.14	23.35	+ 0.21
14	21.20	24.12	+ 2.92
16	19.87	25.22	+ 5.35
18	18.87	26.06	+ 7.19
20	18.06	26.89	+ 8.83
22	17.47	27.79	+10.32
24	16.93	28.66	+11.73

The figures show three important points: First, the cost of producing lumber from trees 24 inches in diameter is only about one-half that of trees 8 inches in diameter, second, the lumber from 24-inch trees is worth 32 per cent more than for 8-inch trees, and, third, trees below 12 inches in diameter are cut at a loss. No stumpage has been charged, but without this cost a loss of $10.49 is sustained for every thousand feet of lumber cut from trees 8 inches in diameter.

Making Operations Permanent

The study shows that even though an operator has no thought of a return cut but wants to get the greatest profit, he makes the most money per acre by cutting only trees 12 inches in diameter and larger. If on the other hand he desires to make his operation permanent and has enough timber to supply the mill, he makes the most money on each thousand feet by taking only trees 16 inches in diameter and larger. In such an event, however, an operator would not wish to cling rigidly to a diameter limit ecause he would not want to place his stand in the best possible growing condition. To do this it will be necessary to cut some poor trees below the 16-inch limit in order to clean up the stand and perhaps to leave a few above the limit in order to fill in thin places in the stand. The volume removed, however, would correspond roughly to the 16-inch diameter cutting limit.

The results of these studies are to be supplied to operators interested in practicing forestry on their lands. Along with selective logging plans should come improved utilization, not necessarily to cut the timber closer but to get more returns from that cut. This is particularly important among the small mills of the South because they are cutting at least 50 per cent of the total production of the region. Some progress is being made in improving small mill equipment, as for example, the portable band mill which is operating in the Coastal plain. This mill cuts a saw kerf less than one-third as thick as that of the circular mill.

Among the agencies that are working to improve the efficiency of the small mill is the Forest Products Laboratory, where especial attention is being given to manufacturing, marketing, and seasoning practice. There are also many developments in the pulping field which will make it possible to use more of the tree. No matter whether a stand is managed for pulpwood, or for sawlogs, or for a combination of both, a proper selection of the material to be removed is exceedingly important and will have an effect on the cost of carrying on the operation. Costs will be one of the most important factors in determining the extent to which wood and wood products hold their place in competition with other materials. Selective cutting reduces costs, leaves the land in a productive condition, provides a method of making an operation permanent, and if widely followed should have a powerful influence in making forest practice more practicable and more profitable.

PLANTING AND PROTECTING SMALL FOREST AREAS

By JAMES FOWLER, Soperton

Experience Indicates that Fenced and Closely Grazed Pine Plantations Have Greater Growth—Cooperation of Tenants Obtained to Control Fires—Planted 1,000 Acres to Pines in 1930—Treutlen County Leads State in Tree Planting.

I am indeed, very glad to be here this afternoon. And then you know there's always something about you Savannah people that makes a countryman feel at home. And another thing, when we Naval Stores Operators get broke we just strike a draft on Savannah, and if it don't come back, our local bank places it on our overdraft.

I consider it a very great privilege to have been born and raised in the country. My father taught me forestry from childhood and he would not allow we boys to cut any kind of a green tree that we could not use. He said to let it grow seven years and we would need it. And one of the many regrets of my life is that I did not put in practice this one thing taught in early life. But, after giving many of our forefathers credit for conservative cutting and protecting the forests, they did not realize the greatest enemy of the forest and that is FIRE. They believed it was necessary to burn the woods at least every two years, in order to have better grazing for their cattle.

We all know that fire is still the greatest enemy of the forests. But in Treutlen County (my home) we have what is generally known as Billy goats, and after having closely watched two separate herds of these goats for the past two years grazing on woodlands thickly covered with young slash pine, I have almost come to the conclusion that goats are almost as destructive to young slash pine trees as fire. Fire will leave some trees in wet and clean places, but the goats will bite out the buds and tops of the young trees all over the forest. I have recently noticed hundreds of small slash pines from three to four years old, with trunks not more than twelve inches high, and I don't believe these trees will ever be of any commercial value, but only be in the way of other timber coming up. Personally, I have put goats in the class with rattle snakes.

Please do not understand that I am opposed to all forms of grazing lands set to young timber. I believe that cattle grazing where the fire hazard is great, to be both practical and profitable, and I am glad to give you the following facts, which I am sure will be of interest to most of you. On May 19th, 1930, assisted by Mr. Jack Thurman, State District Forester of Georgia, we measured the growth in height, made this year, on one hundred representative slash pine trees, which were set out in the spring of 1926, on deep, sandy soil. Fifty of these trees were measured on one tract of timber that had not been grazed since planted, and fifty from land that had been grazed hard for the past three years. The ungrazed land trees showed a growth of 27 and 82-100 inches, and the hard grazed land showed a growth of 29 and 6-100 inches or 1 and 84-100 inches growth in favor of the grazed land trees. When I say hard grazed land, I mean grazed so clean that, by

my permission, Mr. Thurman placed a lighted match and fired five of the thickest places he could find on this tract of land and in less than five minutes, all the fires went out, and this was on a dry and windy day, about 4 o'clock in the afternoon. Now, I am unable to account for the more rapid growth on the grazed land unless the heavy growth of broom sedge and other grasses deprived trees of some of the water and plant food. I will ask Dr. Cary and Miss Guerry to solve this problem for me.

I did not measure last season's growth of these trees but from observation, I was so well pleased with the growth on the grazed land, that I increased my herd of cattle from 150 to 300 head, and have grazed several hundred acres of land growing young slash pines, so that the fire risk is nominal. I not only find cattle good fire fighters but very profitable. 88% of my cows have raised a calf during the last twelve months and I have sold all calves offered at $30.00 to $50.00 per head, age from six to eight months old. I had never owned any cattle before and in order to find out the type best suited to my grazing, I tried the Black Angus, Short Horn, Red Polled and Hereford, I find the latter the best grazers for wire grass and broom sedge.

I have just sown 500 acres of my lowest woodlands, which has a good stand of young slash timber on it, to carpet grass, and have a very nice stand of young carpet grass coming on, and if it can be grazed close as the wire grass and broom sedge, I feel that I have gone a long way toward solving the fire problem in my woodlands. The land I have just mentioned is all under fence, and the land not under fence will have to be protected by plowing and burning fire lanes, because it will be impossible to hold cattle close enough to graze unfenced land on an open range.

After having been quite successful in keeping fire out of my woodlands for three years, I am almost sure it's because I have made all my fire lanes from 25 to 30 feet wide and burned clean between the furrows. Also, cut up into small tracts, the lands where the fire risks is greatest, this of course depending on the density of the undergrowth and kind of grass growing on the land. Fire will cross a 20 foot fire lane, in dry, windy weather and we usually have this kind of weather in March, and this, too, is about the time of year that the tenant farmer, with two or three old cows starts to plowing up his velvet bean fields, and he thinks he must set fire to his neighbor's woods, so that his cows may get some tender grass. Just as soon as we find out how to handle this situation most of our fire troubles will be over.

I'll tell you how I handled 300 acres of timbered land that I bought in 1926. This land had been burned over every spring for the past twenty years and was everybody's cow range. In the spring of 1926, I plowed and burned fire lanes through the woods, cutting it up into about ten acre tracts, and during the month of March, almost every night, one or two of these tracts would burn, first on one side, then on the other, and here is what I did. I first cut all the fence posts I could find on the place and piled them up close to the only farm house on the place that was occupied, bought some three or four miles of wire fence and piled it down and then went around the land getting every fellow that I thought had a cow, to help me locate the land lines, and made it a point to tell him why I had to fence the land and enquired if he knew of any cattle for sale, as I would keep all cattle out but my own when the fence was finished. Well, it worked, for in less

than a week I had several delegations and committees from the adjoining lands call on me and offer to do anything I might suggest if I would not fence the land. Some traded, they were to watch for and fight fires any time of the day or night, and I agreed to hold up on the fencing for a year or two. I used my wire for fencing other lands more than a year ago and have hauled most of the posts away. I have had less than 1% of these woods to burn since 1926 and this fire was traced to fishermen camping on the Ohoopee river, which is the northern boundary of this land. I have increased the size of the protected tracts from ten acres to twenty and twenty-five acres, which cuts my cost down from 15 cents per acre in 1928 to 6 cents per acre in 1930.

As most of you all know, my country—TREUTLEN—is one of the youngest and smallest counties in the state, yet, it ranks first in artificial reforestation. We have an active T. P. O. with several members and 26,000 acres of timbered lands listed, and have had less than 2% of our lands to burn this year. The number of acres of slash pine seedlings planted this year are as follows: Jim L. Gillis, 400 acres; J. B. O'Conner, 150 acres; M. H. Newsome, 25 acres; James Fowler, 1000 acres in 1930 and 500 acres in 1926-27-28-29.

Practically all these trees are planted in ten-foot rows and from six to ten feet in the drill. 6 per cent of these trees are set 6 x 10, giving us 2,075 acres of planted trees and 1,280,000 in number. And the trees set out by James Fowler shows a loss in dead trees of less than 10 per cent to date, and I understand that none of the planting shows more than 5 per cent loss. I am sure that this was due to better methods of transplanting and to the cold wet weather, we had during the winter and early spring.

As far as I know Treutlen county has the only T. P. O. member, who has a pack of blood hounds to chase woods burners. This honor goes to M. H. Newsome, who is one of the largest farmers, land owner and turpentine operator. Mr. Newsome ran down and caught the last fellow that fired his woods—a negro by the name of Sylvester Jordan, who pleaded guilty and got twelve months on the chain gang.

I am glad to tell you people that the State and federal governments are giving the Treutlen county T. P. O. wonderful cooperation and assistance, and it is certainly an inspiration to work under their guidance, and we are very grateful to them for their help. But the greatest assistance we need right now, to help carry forward our leading forestry program, can come only through our state legislature, and that is a reduction in taxes on the lands while we are growing timber and I hope this body goes on record with some resolutions to this effect. I believe this is the opportune time to push this legislation through, while the newspapers and magazines are giving us so much favorable publicity.

You know, that I have about decided that growing and protecting timber is about the most popular business a fellow can engage in right now. I don't mean it is so great for the fellow trying it, but, what the fellow on the outside looking in, thinks about it. The reason I say this is, that before I got into the forestry business, I cannot recall ever having my name and picture in the papers. But, since some of the boys from Washington and Atlanta came down and looked me over, I have had my picture on the front page of several forestry journals, The Atlanta Journal and other dailies. I have been invited to appear before the Congressional Forestry committee, at Washington, received dozens of telegrams and letters from various clubs and organizations,

all about over the United States, asking me to make them a talk on reforestation, etc. Even Mr. Gamble, with the Naval Stores Review and Mr. Bickers, with the Savannah Morning News, two of our most valued papers have offered me space in their papers, and if you gentlemen are present, I want to thank you and promise here and now, that if I ever have any photos made that don't look like me, I'll send you two or three. I thank you.

FIRE PROTECTION IN A LARGE FOREST

By CAPTAIN I. F. ELDREDGE, Forest Manager
Superior Pine Products Company, Fargo, Ga.

Protection Plan on 200,000 Acre Forest—Steel Towers—Fire Breaks, Fire Fighting Equipment, Organized Crews—90 Per Cent Area Free of Fire Cost Average Below 4 Cents Per Acre—Stand of Cut-Over Land Increased From 35 Per Cent to 100 Per Cent in Five Years

In covering my subject I shall hold rather closely to a description and discussion of the fire protection measures we are taking in Suwanee Forest, and shall not attempt to lay down general rules for fire protection good on any large tract.

First, let me briefly describe Suwannee Forest. This is an area of more than 200,000 acres located on the west bank of the Suwannee River, along the Georgia-Florida State line in Clinch and Echols Counties, Georgia. Its area is one hundred per cent timber land. It was logged of its original stand fifteen to thirty-five years ago, about ten per cent of the original growth still standing. The main stand now present is a good second growth of slash and long leaf pine from one to thirty years old.

Thirty per cent of the area is in pond, bays and swamps. The land is a level, loamy sand with numerous streams but rather poor drainage.

We have an average annual rainfall of about fifty-six inches with two extended dry spells to be expected each year, one in April, May and June—the other in October and November. Actual experience has shown that there are wet years and dry years that upset all calculations based upon average figures as to fire hazard.

In Suwanee Forest there are at present six turpentine camps and five logging camps. Including our own there are three standard gauge railroads in the tract, traversing fifty-five miles of land and carrying from eighteen to twenty-four trains daily.

Turpentine farms surround the forest on all sides and the range cattle of at least twenty different owners graze in it; two highways cross the area and many hunters and fishermen are in the woods in season.

It may seem from the above that all of the most prolific sources of forest fires are well represented and that the opportunity for the starting of fires at all seasons of the year is manifold.

The plan of protection I shall outline to you is by no means original, unique or perfect—it follows the well tested principles worked out during the last twenty-five years in the National Forests of the Federal Government, but has been modified and fitted as well as may be to local conditions. Furthermore the plan is more or less elastic and has been changed and will continue to be changed from time to time to take advantage of experience and knowledge gained by us and others and to follow closely any change in the situation that may develop.

Plan of Organization

The aim is to achieve adequate protection from fire at the smallest possible cost.

The decision to protect our timber lands from fire was made after a careful analysis of all conditions affecting timber growth and the production of commercial forest products and after a weighing of costs against expected results.

The forest area is divided into six ranger districts of from twenty-five thousand to forty thousand acres each, the size depending upon the relative fire danger, accessibility, and the amount of other duties than protection to be attended to. A district ranger, who has both auto and horse, patrols this district against fire and trespassers. In season of high fire hazard this work may fully occupy his entire time —At other times he attends to such work as marking timber for cutting and cup hanging, counting cups, scaling, measuring or counting saw logs, poles, ties, etc., inspecting and enforcing chipping and logging requirements, enforcing fish and game laws, surveying land lines, building and repairing telephone lines, fences, etc.

The constant presence of these men in the woods is primarily a fire prevention measure and is usually quite effective. They all bear commissions from the State Forestry Service as Deputy Fire Wardens and have the right to carry arms. These patrolmen also serve as smoke chasers; that is on discovery and location of a smoke by the towers they at once, with one or more laborers, go and start work on the fire.

In the flat woods, now so stocked with young timber that you cannot see more than a few hundred yards in any direction, it will not do to depend on the discovery of fires by patrolmen, nor is it safe to count upon the discovery and reporting of fires quickly by employees in the turpentine or logging woods, or by travelers. At the same time it is vitally necessary that all fires be discovered, located and reported quickly in order that they may be attacked before they have had time to spread over a large area.

Steel Lookout Towers

To meet this need we have erected and maintain three steel lookout towers, each eighty-two feet high, located so as to overlook the entire area. Watchmen are kept in these towers during the season of fire danger; going on duty an hour after sunrise and staying up until dark and going up for final look around at about nine P. M.

The towers are connected with each other and with the office at headquarters by telephone lines and the same system connects the office with ranger stations, sawmills and turpentine and logging camps.

In each tower there is an Osborn Fire Finder, an instrument by means of which the actual location of a fire seen by two or more towers can be accurately determined within a minute or two after the smoke is seen.

The entire personnel of the company in all of its departments, and including that of all of its associate contractors and lessees, are available day and night for fire fighting. All employment contracts are made with the understanding that every man must prevent fires so far as he can and must fight fires when necessary.

It is undesirable to stop or hold up production activities such as logging, sawmilling or naval stores operations except as a last resort. We have found it more effective and much less expensive to maintain during the fire season one or more small crews of specially trained men equipped with fire trucks and necessary tools that can be dispatched in short order to fires. These men know their stuff and being able to respond quickly and travel rapidly can get to a fire while it is still small and with adequate tools at hand can usually take care of ninety per cent of the fires without calling on the operating departments for help. Between fires these crews are kept on road and bridge work, in thinning out sapling thickets, peeling pulpwood or similar work but always within easy reach and always ready to move, fully equipped, on short notice.

The fire trucks are equipped with hoes, axes, rakes, brush hooks, back-fire torches and hand water pumps and carry one hundred fifty to two hundred gallons of water in drums.

At each ranger station and turpentine camp there is kept a supply of hand pumps and one or more drums of water that may be loaded on turpentine or logging trucks and taken out with extra men to a fire if needed.

If the regular fire crew fails to quickly control a fire, as indicated by the report on the smoke from the towers, additional men are called out from the nearest operating crew and taken to the fire in trucks and added to the force. As soon as a fire is controlled the additional men are returned to their work and the fire left in charge of the regular crew to be secured before it is left.

Fire Breaks Maintained

As an aid in the control of fire and, mainly, as insurance against wholesale destruction of young growth over a large area we make and maintain a system of fire lines which cut our young timber areas up into blocks of from one hundred to one thousand acres each; the size of the area being governed by the relative fire hazard as well as the need for intensive protection. As time goes on we will continue to increase the mileage of fire lines and reduce correspondingly the size of the protected blocks.

Our fire lines are from fifty to sixty feet wide and are made by putting in two single furrows, one at each edge of the strip with a Fordson tractor and a side disc plow and burning out the undergrowth and grass between. The lines are run to take advantage of the country, usually following along old turpentine and logging roads. Experience has proved that we cannot depend upon swamps, ponds or bays as fire stops in dry weather.

Fire lines such as we make cost about $10.00 per mile. It is my opinion that we would not be justified in this expenditure on the basis of their immediate use in controlling the fires of today. The real need for these lines becomes quite apparent if the conditions that will prevail five years from now are visualized. At that time we will have a number of very large areas covered solidly with dense stands of young slash pine mixed with an undergrowth of gallberry and palmetto. In such stands, in dry and windy weather a fire is very apt to get into the crowns of the trees and become uncontrollable. The only way to successfully combat such a conflagration is to backfire from strategically located prepared lines that interpose a distinct

break in the crown canopy. It is cheaper to make these lines now, while the seedlings are so small that they and the grass and undergrowth can be removed safely and prevented from coming back by periodical burning, than to wait until the need becomes truly imperative and then cut through dense stands of saplings and face not only a much increased cost but also the difficult problem of burning large piles of felled saplings in an extremely dangerous position.

Needless to say, places of special fire danger, as for instance main traveled roads, railroad right of ways, around sawmills, favorite camping places, etc., are located and given special attention in the way of fire lines. In places where the investment is particularly high such as crops of turpentine cups, buildings, camps, trestles and bridges, etc., are protected by fire lines.

It is an axiom that it is better to prevent fires than to fight them and we use every opportunity to reduce the danger of fire starting by accident, by carelessness and by design. Signs are posted everywhere warning against fire. Employees are kept constantly reminded of the necessity of care with fire in the woods. Locomotives, skidders, loaders, saw-mills and other fire using equipment are inspected frequently. A continuous personal contact is maintained with neighbors, both cattle men, naval stores men and other users of the woods to enlist and keep alive a friendly and cooperative attitude towards fire protection. Campers, hunters and fishermen are allowed the freedom of the forest only under permits which contain a fire clause."

While there has been, thanks to the splendid efforts of the State Forestry Service and the American Forestry Association and other agencies, a marked change for the better in the attitude of the public towards the burning of the woods, there is much left to the accomplished in this line. By far the greater portion of our annual fire loss is due to man caused fires. The activities of a very small group of little cattle men in a remote section of our holdings who have not been brought to a realization of the harm they are doing us and their community, is responsible for most of this loss. These men are not representative of the general run of cattle owners that use our property, for in ninety per cent of our area we have obtained the successful cooperation of cattle men in preventing fires.

It will take time and continued effort to get a full one hundred per cent appreciation of the benefits and worthwhile results of fire prevention, and to fix in the minds of all men that it is criminal to destroy forest property for the sake of a few range cattle, but it is by no means a hopeless or impossible task. Sustained efforts will give the desired results.

Effectiveness of Fire Prevention Methods

What does it cost to maintain the system of protection outlined above? An examination of our records for the last four years shows that the expenditures charged to fire protection amounts to an average annual cost of 5 7-10 cents per acre. Of this cost the Federal and State governments contribute 1 7-10 cents, leaving the net cost to us of 4 cents per acre.

How effective is the system? In 1926, the first year of protection, we had no towers and were otherwise poorly organized. Furthermore there had been little opportunity to reach the convictions of the woods using people. We had ten per cent of our area burned. The burns being pretty uniformly scattered throughout the forest.

1927 was the dryest year the Weather Bureau had recorded in thirty years, with ten months of dangerous fire season. Our loss that year was seven per cent of the area, again rather uniformly scattered. In 1928 weather conditions were more favorable and we were well organized. Our loss was confined to 7-10 of one per cent of the area.

In 1929 the loss was 6-10 of one per cent. In the last two years ninety-five per cent of our burned area has been concentrated in ten-per-cent of the forest area. That is to say, on ninety per cent of the area of our property we have had practically no loss.

Better Stand Under Fire Protection

The next question that will occur to you is, "What are you getting for your money?" I could show you in a day's inspection of Suwanee Forest much more convincingly than I can tell you what "four years of protection has brought about in the way of increased growth of standing timber, increased production of naval stores per crop, and increased stocking per acre of young growth. I can show you for one thing areas totalling by conservative estimates more than 70,000 acres which five years ago our cruise showed to be only thirty-five per cent stocked which can now be classified as from ninety to one hundred per cent stocked." This young growth is from one to eight feet in height and stands from five hundred to five thousand per acre. I can show you thousands of acres of established sapling stands that have put on an average of ten feet of height growth in the last five years. I can show you hundreds of crops of turpentine timber that five years ago were estimated to hang, according to our ten inch diameter limit, an average of four thousand cups per lot that now will hang from eight to ten thousand per lot, and, finally our crop production records show that using the same method of turpentining we are getting five barrels more of gum per crop now than we did the first year of operations when all turpentine crops were raked and burned. These things translated into dollars and cents pay many times over the cost of protection.

Game Population Increased

"As a side line, not perhaps of interest from a purely financial standpoint, it may be stated that the effect of fire protection on the game population is beginning to be very marked. Deer, bear, fur bearing animals, turkey and quail are increasing very rapidly and while some of this increase is due undoubtedly to protection from excessive hunting the greater part of it can be laid to improved conditions in range and cover."

What of the future? Will the fire hazard increase or decrease with continued protection? How about the cost in the future? What of the danger of tremendous conflagrations? These are all fair questions and must be squarely faced. In my opinion, for a number of years to come we must in Suwanee Forest expect to find our task increasingly difficult, and more expensive, and with greater danger of large losses. Just how long a time must elapse before the situation changes it is difficult to say and I can only venture the opinion that the next ten years will be the hardest. Undoubtedly, somewhat greater damage by fire is done in rough woods than in periodically burned woods. It is easily established that the difficulty of controlling fire in

rough woods is greater and therefore its cost is greater. Then too, fires start easier in the rough than in burned woods. However, we have every right to expect that we can improve and cheapen our methods of protection; that we can educate the woods using people to a point where man caused fires, now the chief source of loss, will be reduced to a low figure. We can expect more stringent legislation and greater protection from the Courts and I see no reason why we should not expect an increased participation on the part of the State and Federal Government in the active cost of protection so that altogether it appears to me that while we should not kid ourselves as to the diciculty of the task ahead, we may look forward confidently to its successfus accomplishment. I feel certain that no intelligent timber owner who is planning to hold on to his timber land with a view to continuous operations will be satisfied to forego all of the financial benefits to be obtained by protecting his lands from fire through faint heartedness as to his ability to meet the future developments.

RAILROADS AND FORESTS

A. E. CLIFT, President, Central of Georgia Railway Company, Savannah, Ga.

Railways Purchase 11 Per Cent of Country's Timber Output Besides 105,000,000 Crossties—Products of Forest Exceed Agriculture In Tonnage on the Central of Georgia Railway—There Are 7.48 Acres of Forests for Each Man, Woman and Child In Georgia—Second Growth Pine Keeps Up Lumber Production and Has Restored Georgia to First Place in Naval Stores—Wood Pulp Prospects—Instensive Education on Forestry a Need

My assignment is to speak for the railroads on this program, which is to record the true worth of forestry products to the State of Georgia. I wish to begin with the acknowledgment that many railroads now operating in the state owe the very existence of important parts of their mileage to the forests. Indeed, it may be said that no industry except sawmills and naval stores is so intimately related to the history, future and fortunes of forests and forestry, as is transportation.

Much of Georgia's railroad mileage of today was built into virgin pine forests years ago, for the purpose of handling lumber and naval stores. Built as logging roads, these lines developed into common carriers, and are now operating either as short lines, or as parts of trunk lines.

Railroads are large purchasers of timber. In turn, they derive large traffic from forest products. Railroads are co-operating in every way possible for the welfare of the industry. Each of these relationships affords opportunity for discussion that could easily consume the time allotted for this presentation. To touch on all of them permits me only to refer to the high points.

The railways purchase 11% of the country's timber output, without taking crossties into consideration. The various construction industries purchase 60% of the output, the manufacturing industries 18%, and miscellaneous industries the remaining 11%.

The railways last year used 105 million cross-ties, of which 92 million were untreated and 13 million were treated. It is worthy to note that railway purchases are usually of the better grades of lumber, because of the longer service. A railroad's plant and equipment must at all times be kept in condition to render efficient service, hence require frequent renewals.

The lumber industry creates important traffic for the railroads. Most people if required to hazard a guess would perhaps surmise that the principal traffic moving over the Central of Georgia Railway is products of the farm, since Georgia and Alabama are known as agricultural states. As a matter of fact, of the 4 great divisions of traffic, products of agriculture last year stood fourth, with 13%; products of forests showed 20%; products of mines and products of factories 29% each.

In a state abounding with mineral wealth, having such a variety

of minerals, and particularly such vast resources of kaolin, the casual observer is apt to assume that Georgia's greatest natural resources are found underground. But when one studies the matter and digs into facts and figures, it becomes apparent that Georgia's greatest natural resource is her forests. The state forestry department—and a very efficient one it is—tells us that there are now 23 millions of acres in forests in Georgia. That is about 64% of the total area, or 7.48 acres for each man, woman and child in the state. There are 6 millions of acres more in uncultivated farm lands that could be added to the forest area, without curtailing agricultural production.

The original long leaf pine belt of Georgia, which was then largest of the Atlantic forests, covered 19,000 square miles, or more than one-third of the area of the State. Professor Sargent, who made a computation of the standing timber in 1880, estimated it as 16 billion, 778 million board feet.

Georgia led in the production of long leaf pine lumber until 1904, yielding first place to Louisiana and dropping from first to eighth in rank. The peak of production in Georgia appears to have been reached in 1899, when it was one and a quarter billion feet.

It is interesting to note that while the production of long leaf pine in Georgia has declined rapidly since 1900 and is now almost negligible, the production of second-growth pine and other species has kept the producton fairly constant. The total production of lumber in 1900 was one billion, 311 million feet; in 1909 it was one billion, 342 million feet; in 1924 one billion, 89 million feet, and in 1927 one billion, 201 million feet.

The virgin pine was cut principally by mills of large capacity located on the railroads. These mills were equipped with dryers, planers and other finishing machinery. As a rule, the mills owned thousands of acres of timber or timber rights consolidated in large bodies. Logging was done by tram-road and in a few cases by rafts or drifting.

Today the second-growth timber is rough-sawed by small mills, located maybe several miles from the railroad, and the rough lumber is concentrated at central points on the railroad for drying, finishing and shipping. This change in the methods of manufacture is shown by the fact there were 335 mills on the Central of Georgia Railway in 1903. Our latest directory, issued in January last, showed 468 plants. Timber is now bought in small tracts and the mill moved where it can be reached by trucks or teams.

Income From Georgia Forest

Georgia's receipts from her forests, including naval stores, approximate 125 million dollars annually. These industries give employment to some 35 thousand people with a payroll of 24 million dollars. At an average of five people to the family, it means that something like 150 to 175 thousand people in the state derive their support from this source.

Taken alone, these are impressive figures, but we are getting the best returns from this crop and these industries which occupy more than two-thirds of the area of our state and contribute so materially to our welfare. The State Forester tells us our losses from forest fires every year are four to five million dollars, and that organized fire protection, which would obviate the bulk of this loss, can be had

at a cost of three and a half cents per acre per year.

The Commissioner of Revenue of North Carolina stated recently: "Some of our forestry experts, who are familiar with timber growth in this southern area, are of the opinion that an acre of woods land, fairly set in thrifty growing young trees, properly protected and intelligently thinned in a process of gradual harvesting, will yield an average of $5.00 per acre per year in the value of added timber growth."

Naval Stores' Revival

The come-back of the naval stores industry in Georgia is a gratifying and encouraging aspect of the present situation and the future of our forestry problem. I observe that in 1890, when Georgia had great areas of long leaf pine, that were the resource of our naval stores, the state produced 52½% of the total production of naval stores. By 1900 the percentage had dropped to slightly less than 40%, and there was a steady decrease until it reached the lowest figure in 1918, which was 19¼%. Beginning the following year, 1919, the production made a steady increase, and in 1928, the latest figures available, the production in Georgia reached 46¾%, and has led all other states in volume of production since 1923, when the lead was wrested from Florida.

Such a recovery is unusual and is due, I think, (first) to the beneficient act of nature in re-planting our cut-over and waste lands; (second) the improved methods of extracting and distilling gum, and last, but not least, the constructive ecorts of the naval stores factors, dealers and exporters in Savannah, and perhaps elsewhere, to maintain the market and develop new uses for the products.

Despite the waste in the old method of boxing, as well as in the logging and manufacture of our virgin pine, the two industries, crude as they were, gave employment to a large number of people and contributed many millions of dollars to the welfare of the South.

I am persuaded, however, that if we will reforest our idle and waste lands; give the proper attention to the protection of the forests; practice selective logging; our slash and second growth varieties will prove vastly more important commercially.

New Uses for Georgia Pines

We are indebted to science for this happy outlook. Dr. Charles H. Herty, with his improved methods of extracting the gum, restored and made permanent the naval stores industry. Kraft paper is now derived chiefly from second-growth pines. Recent experiments give hope they will soon be available for book and newsprint paper and a base for rayon and other products.

Obviously, this is primarily an educational problem and we must be patient and persistent in solving it. I think much credit is due the State Forestry Department, the State Agricultural College, the Forestry Associations and the individuals who have co-operated in the work that has been accomplished, but with more funds and more sympathy and co-operation, better results could have been obtained.

We need an intensive campaign extending down through County Agents, railroad Agricultural Agents, Chambers of Commerce and others who can be enlisted to bring to the individual farmers or land owners the methods of re-forestation, the necessity for fire protection,

selective thinning and the other things they should know, to the end the farmer or land owner may have an additional source of income from these abandoned or waste lands. The railroads co-operate in fire prevention by burning weeds and brush from their rights-of-way in the Fall of each year. Railroads also prolong the life of ties and timber by treatment with creosote.

It appears to me our objective at present, after reforestation and the protection of the trees, is to find new uses which will bring larger returns.

Pulp and paper appear to offer a hopeful prospect and for a large consumption. The South has made a good start in the manufacture of Kraft and other of the coarser grades, but recent experiments give hope we can also make newsprint and book paper from our slash and perhaps other second-growth varieties.

Farmers of Louisianna received $1,650,589 from the sale of pulpwood from their farms during 1929, according to figures compiled by the agricultural extension service of Louisianna State University. This sum was paid by six pulp and paper mills of the state to farmers in 13 parishes. The amounts spent by individual concerns ranged from $24,000 to more than $800,000. Many farmers of the state with these splendid markets at hand are beginning to grow timber as a crop, according to Robert Moore, extension forestry specialist.

The United States imports about 60% of our total paper requirements. The domestic demand is rapidly increasing, while the foreign supply of pulp and paper is not only decreasing, but advancing in price.

The State of Georgia offers many locations where paper mills can secure the two requisites of pulpwood supply and suitable water.

The country needs the lumber and finished products of our forests. The production and manufacture of these affords a field for labor, management and capital that is important to our people as a whole, and to the railroads that serve them.

In the last analysis, the railroads are interested in forestry, not only as a carrier and a purchaser of its products, but because proper conservation, protection and handling of timber resources, promise enhanced prosperity for the people of the state.

WOMEN'S CLUBS AND FORESTRY

MRS. S. C. TOWNSEND, St. Marys, Ga.

How a Woman's Club Helped Organize an Entire County in a Timber Protective Organization—Education Campaign Won Results

It is indeed an honor to represent the Women's Clubs of Georgia. They are composed of fine, loyal women wielding a powerful influence for good in any community. The woman's club is an excellent school for the older woman, who has been entirely occupied hitherto with home affairs, in which she may learn to readjust herself and to get her bearings for new phases of usefulness, after she suddenly realizes daughters and sons are educated, married and gone; husband is still absorbed in business affairs, and that now she must fine new interests and diversions.

But why Mr. Woolford selected me to take Mrs. Gaffney's place on this program, I do not know. I am not an outstanding club woman. I do not know what the State Federation has contributed in behalf of forestry interests. This morning this report of the Forestry Committee of the Atlanta Woman's Club was handed me by an Atlanta friend of Mrs. Guy Woolford, who was chairman of their department. Mrs. Woolford originated the idea of planting Peachtree Street in peach trees, and who can say she isn't largely responsible for our president's interest in forestry? My selection must be due to the fact that of the three women in constant attendance at the conference, two were identified in other ways and, on such short notice, I only was available. When I was asked yesterday to make this talk—realizing my ignorance of Federated facts and data—I was aghast. Yet, I could not refuse one who has already done so much for Georgia along the lines in which I am most interested, and who, I predict, will accomplish a great deal more. So, the only way I know to keep my promise is to tell you what one club woman has done for forestry in Camden county.

In 1912, I believe it was, I organized the little Woman's Club of St. Marys, and was its president until 1922. An awful thing to inflict on those people, but in those days the woman's clubs idea was not so popular, and I had to take care of "my child."

In trying to carry out the many worth-while things attempted by the average club, such as better schools, better health, etc., I found a woeful lack of funds, and this thought came to me—why not help to increase the income of our people to supply this need? A mental survey convinced me that Camden county's greatest asset was her pine trees—97% of her total acreage—except, of course, her magnificent harbor and extensive waterways. With the help of our State Chamber of Commerce, which was then the Georgia Association, and friends of my husband from over the state, a county-wide association was organized. This club woman was elected secretary treasurer.

Through this association, county agents were secured, and we all began immediately to preach the gospel of forestry and game conservation. Hundreds of posters were secured from the State Forestry Department and put up everywhere possible. Mr. H. B. Reddick, an outstanding naval stores operator, assisted me in putting

up a forestry exhibit showing the right and wrong way to scar a tree. The State Forest Service brought along a fine exhibit. The forestry exhibit and the best exhibits from the county fair were taken to the district fair and won second prize. The Club Woman and the County Agents put up the exhibit.

Forestry essay contests were put on in the five splendid consolidated schools in Camden county, and prizes were awarded by the local Woman's Club. At about this time the president of the 11th District Federation of Woman's Clubs appointed me Chairman of Forestry and Natural Resources—a department not in existence in this district up till the time of my appointment. More posters and literature from the State Forest Service was sent to the various clubs. A forestry essay contest in the Eleventh District schools was sponsored by the Eleventh District Woman's Clubs. Prizes were awarded by the clubs except in Clinch county where Captain Eldredge's company—Superior Pine Products Company—gave the prize. Forestry programs were also held in the clubs and the subject really studied.

The State Forest Service has grown during these years and has done a lot of very fine work in my district. In Camden county their efforts were crowned with a measure of success last fall by the large land owners, together with some of the smaller ones, coming together into a Timber Protective Organization. Solely because of her efforts in behalf of forestry, this club woman was elected secretary-treasurer.

The lookout tower system is managed by the secretary. The T. P. O. has two lookout towers one hundred feet high. Forty-eight miles of telephone line will be completed this week. The third tower in Camden has been independently owned and operated this first season, but will be affiliated with the organization, we believe, after the meeting to be held June 14. We expect to have two forestry school demonstration plots next year, situated on the railroad and the coastal highway. At this meeting, reports will be given and plans made for next year which begins July 1. Mr. R. E. Price, open-minded and progressive, is manager of approximately 125,000 acres of land. He is working tirelessly in the timber protective organization for the conservation of game and forests. Our ambition is to see two towers north of the Satilla river, which would make Camden county 100% under protection.

Now, ladies and gentlemen, I have enjoyed doing this work. In fact, it has been a real pleasure, BUT I have not enjoyed talking about it. I would have much preferred that the subject could have been covered by someone else or in some other way. I do not know anything about forestry. (I don't feel so ignorant, however, since I have heard a number of these eminent men say the same thing). I have been trying all these years to learn something about it, and I came up here for that purpose. I would like to say here that I have received a great real of valuable information, which I hope to take back and disseminate to the club women and the public generally. However, what one club woman has attempted to do, any and all can do. For in the last analysis, it is what you and I do—in our clubs—in business, and all through life, that makes the final record.

VALUE OF FORESTS TO POWER COMPANIES

By CHANNING COPE, Field Representative, Georgia Power Company

Forests Provide Insurance Against Reservoir Depletion During Droughts and Retard Erosion Which Eventually Would Fill Reservoirs and Decrease Available Power—Power Companies Regard Forestry Resources Important to Development of State and Are Anxious to Promote Forestry.

The question of the value of forests and forest products to power companies brings the observer at once to the question of water power development. While it is true that great quantities of forest products are used by power companies at present it is also true that these products are becoming of less importance as the art of generating and transmitting electrical energy progresses.

The production of power through the utilization of waters of rivers and streams is a many-sided problem. Values of the separate sides of the question are rapidly changing, each one in itself, and in relation to the others. Probably the most important phase of the question is the ultimate cost of power to the consumer. Twenty-five years ago the generation of power by steam, utilizing fuels then available, fixed the cost of power at the point of generation, at what would be considered as compared to today's cost, a very high figure. At that time many of the water power situations, although requiring large sums of capital investment, could be developed and the power sold at less cost than power generated by fuel-consuming equipment. Many of the water-power projects developed and put into service at that time could not be considered today because the total cost of securing power from these sources would be considerably higher than for the same amount of power generated by other means available to the industry today. This has been brought about largely by recent advances in the art of generation and in new economies in the use of fuel. Twenty to twenty-five years ago the generation of one kilowatt hour at the output buses of a central station averaged, in the over-all operation of plant, approximately four to four and one-half pounds of coal of good grade. This figure, expressed in terms of heat units, considering a fair average of coal heat unit value, would amount to between fifty-four thousand and sixty thousand b. t. u. per kilowatt hour at the busbars. Today in well-designed, carefully operated, large output generating plants, one kilowatt hour delivered to the output busbars of a steam station can be secured for an expenditure of twelve to fourteen thousand b. t. u. And the end is not in sight. In some instances a kilowatt hour is being produced at an expenditure of only 10,000 b. t. u. and the more optomistic men in the industry look forward expectantly to the time when a kilowatt hour can be produced at an expenditure not to exceed 8500 b. t. u. This means that the production of power from combustible fuels can be accomplished for approximately twenty-two percent of the fuel requirements of the earlier period. This relative figure will hold among all those steam plants that have been designed and con-

structed within the last three or four years.

Another important phase of the problem of power production thru the use of water power lies in the fact that as a matter of course practically all of those potential water power sites which could be developed under the most advantageous conditions as regards capital outlay, taxes, stream control, and availability to market, have been constructed to meet the power needs of distributing companies. This means that today available water powers in certain sections will cost more per unit to develop than the average of those that have been developed have cost in the past. Lands to be used in reservoirs cost more per unit. Construction difficulties at many of the remaining sites are serious obstacles because of their overall cost.. Many of the potential water power sites can be developed only for relatively small amounts of water, and the cost of developing the multiplicity of these relatively small power units, and the added cost of operation, all tend to prohibit the utilization of these sources of power at this time.

In Georgia, however, we have a rather different set-up than in most of the other states. Water power developments are of prime importance. About 94% of the power generated by the Georgia Power Company comes from hydro plants and very properly so. Owing to the location and size of these developments it is of economic advantage to maintain the present plants and continue to build other hydro developments of suitable size and at strategic locations. One of the principal difficulties of a power system based almost entirely on water power is the matter of insufficient water supply during periods of drought. This problem has been met in Georgia through an inter-connected transmission system throughout the Southeast whereby the physical properties are connected and power delivered to the required point. This Southeastern inter-connected system is the first of its kind. It provides power insurance. It makes Georgia's hydro developments commercially practicable. It provides the way for continued development of large hydro plants located at suitable points. But it should be regarded as power insurance rather than as a ready source of power. It will be seen then that steam plants will be needed from time to time to meet the continued demands for additional power. These plants will be located at strategic points, where the costs of transmission from hyrdo plants would be more costly.

In a word the situation in Georgia is about as follows:

Hydro electric power will remain our principal source of power for sometime to come. New hydro developments will be undertaken as demand warrants and in such cases as the location and quantity of water justifies, due reference being made to new economies in electrical generation by the utilization of fuels.

The interconnected system provides power insurance.

New steam plants will be added as conditions warrant, due reference being made to the transmission costs of hydro electric power.

Viewing the problem of preservation of timbered lands and reforestation and taking into consideration the statements above, it would seem that the electric power industry would be directly concerned in the general forestry problem to the extent that this movement in forestry would tend to offer some measure of insurance so that those reservoir developments which have already been constructed would be, in a measure, protected from the gradual filling up

by unrestricted run-off, which carries with it excessive amounts of silt. Under the best of forest and undergrowth conditions surrounding our streams there will always be some considerable amount of silt which, through a long term of years, will sooner or later reduce the storage capacity of these reservoirs to the point where their value as reservoirs will cease, and only normal run of the river will be available for the generation of power at any time. The chief interest of the power industry at this time would seem to lie largely in determining what increased length of life will be secured for those reservoir capacities which are now developed.

However there is another phase of this question of the value of forests which affects power companies indirectly but to considerable degree. Power companies are permanent institutions, if any business can be called permanent. They do business within a certain locality. They grow or decline with that locality. Anything that makes for the betterment of that locality is of interest to them.

In the company which I represent, we regard it as good business to do anything we can to further the prosperity of our territory. We now serve more than three hundred towns. We are tied up with Georgia definitely and permanently. Anything that adds to the material welfare of Georgia adds to our welfare. Then again, we claim to be citizens wherever we serve. We want to be good citizens, valuable citizens. A good citizen is interested in his community and state even beyond the pocket-book factor.

It is obvious then that the power companies have a genuine interest in the forestry program. We are directly interested in the movement in that it helps conserve our reservoirs without which hydro electric developments would not be commercially feasible, we are less directly, though still vitally interested in the movement in its aid to the economic and social progress of our state.

I predict that you will find the power companies of Georgia ready to cooperate with you in the future as they have in the past.

FORESTS FOR RECREATION

By WILLIS B. POWELL, Indian Springs, Ga.

Cool Retreats of Forest Havens and Nature's Temples Need of the Times—State Forest-Parks Windows to Forestry—Georgia's Forest-Parks Described.

The forests were man's first temples. There in the darkling wood, amidst the cool and silence, surrounded with the mystery of the jungle, he knelt and offered up his solemn thanks and supplication. Through the dim and misty pathways of civilization the deep wood has been the refuge of mankind. Here was found solace and relief and comfort from the blazing sun or the blasts of winter. He would be an anchorite who would not stand in awe and veneration of the handiwork of God who has woven into the fabric of the woodland a majestic grandeur and overwhelming loveliness.

To-day a condition, not a theory confronts us. One can travel interminable miles without finding a cool retreat open to the public. The remaining woods are only to look upon as part of the scenery but not to enjoy physically.

Realizing this condition the Georgia Forestry Service is trying to maintain areas of woodlands of greater recreational value by setting them aside as state properties under a definite plan of management which will safeguard their value to the greatest number of people.

The Georgia Forestry Service is motivated with the thought that these playgrounds, these recreational areas, these breathing spots—will be the show windows of forestry. They will create in the average person, a greater desire for further knowledge of the problems of timber growing, protection and utilization.

Forestry will not lose any of its commercial importance coupled with pleasure, nor sentiment suffer through thoughts material. The contact with these recreational centers will strip forestry of all its mysteries and translate the general purposes and methods into terms the layman may understand.

While the Georgia Forestry Service, in its plans and purposes, to establish five recreational centers, located as regards its boundaries;—east, west, north, south and one central—is, primarily altruistic it also has under consideration that its main objectives will be amplified and strengthened through these enterprises. The indirect benefits would be

1—To fetch the general public in closer touch and sympathy with the work of the forestry department.

2—To those who love hunting the lesson will be brought home that without a forest home there can be no game.

3—To those who love to fish the lesson will be brought home that without an adequate water supply there can be no fish. Fish cannot breed and live in raging torrents one week and dry bottom the next, nor will fish bite when waters are laden with silt.

4—To those who love the Great Out Doors and the trees and the forests the lesson will be brought home that one of the greatest

questions before the American public today is forest conservation and reforestation.

The Forest Service of the state has under its management at present Indian Springs in the central part and Neel's Gap in the Northern, the latter known as the Vogal State Forest Park.

Indian Springs gets its name from a mineral spring located in 1792 by a hunter named Dunlap, escaping from a band of Creek Indians. The Indians called the spring "Healing Water." Fearful that the gambols of the squaws and pappooses might drive the spell from the curative properties of the water they never camped near it. Indians of the Creek tribes came from vast distances to drink of the water and when a cure was effected would return to their wars or hunting grounds. About 1800 General William McIntosh, a half breed and a cousin of Governor Troup, erected a cabin here and spent his summers with his family close to the spring. Rival factions of the Creeks, headed by General McIntosh and Napothlehatchie began warring in 1821 and continued the onslaught until 1825. It was in 1821 that McIntosh ceded to the United States government all the Creek lands lying between the Okmulgee and Flint rivers, except about 1000 acres of which the springs were the center, McIntosh reserving this land for his own purposes. In 1825 a second treaty caused the warring factions to meet at the Springs the government agents being protected by United States troops. Under the treaty entered into then the Indian possessions in Georgia were ceded to the whites. This treaty was the undoing of McIntosh who was assassinated a few months later. The speech to incite the natives to this action was made from a rock which remains on the Varner estate, suitably inscribed by a bronze tablet. In 1826 the property was divided by the state into town lots, the state reserving ten acres around the mineral springs for the free use of the public for all time. Here the state has a large casino, pavilion, bath rooms, lodging rooms, and so on, and the acreage landscaped and beautified as funds will permit. Three years ago the state placed this property under the management of the Forestry Board, and the Forestry Board created an advisory board to pass upon improvements. More than 100,000 people visit the springs annually, some Sundays the attendance being in excess of 12,000 people.

The Vogel State Forest Park is located in Union county, Georgia, near Blairsville, on federal route 19. This park has an area of 160 acres, the gift of Mr. Vogul, of Wisconsin. Through the park runs Neel Gap, a popular scenic highway from Atlanta to Asheville penetrating one of the most picturesque areas of the Southern Appalachians. At the highest point, 3108 feet, the Georgia Forest Service maintains ranger's quarters and a concession for the benefit of passing travel. Loyal citizens of Blairsville have created a picnic grounds and tourist camp near by the ranger's home, where the people luxuriate beneath majestic trees, and surrounded with rhododendron and laurel and riot of mountain flowers. A stream bisects this recreational area. This year the American Legion of Georgia purposes to construct on Blood Mountain a memorial to the Georgia World War dead on the summit of Blood Mountain, some 1500 feet higher than the highway elevation. The top of Blood Mountain is now reached with a two-mile path winding up its sides. The possibilities of this recreational area are unlimited. It has an appeal that is irresistible. Here one can look upon a number of waterfalls, or a

vista for miles where on clear days the highest mountain in Georgia, Enotah Bald Mountain, 4800, can be seen; oft times one is above the clouds. Thus we have the mountain scenery of the North and the mineral springs of the central parts of the state provided for. There is still on the program a recreational area for the ocean border; the enchanting beauty of the Okefenokee swamp, and the hill country of the Caloosahatchee river.

But I would not stop there, nor do I think that the people of this great commonwealth will stop with the example set by the state forestry service. There will come a broader understanding of forestry, in all its ramifications, when every county of the state will set aside an area of virgin timber for the use of the public, the area to be beautified and developed and maintained through a small levy on general taxation, thus insuring perpetuity and ever-inviting appeal. By county units the plea and plan of forestry would be broadcast locally and practical demonstrations made that would register. It would afford each county a playground, a retreat, a community center. The Boy Scouts, the Camp Fire girls, the American Legion and other civic and cultural and religious societies would have a home in the Great Outdoors, and where their combined energies would be centralized, drawing the communities closer in bands of fellowship. Their activities would find vent in building lodges, community houses, swimming pools, amusement devices, and in beautifying the grounds.

That this would have an appeal is without question. In every one of us there is a craving to wander out into the romantic and appealing regions where life is different.

And after I have written, in my humble way, it was Cowper who covered the entire ground in that classic which goes rebounding through the ages:

> "God made the country and man made the town,
> What wonder then that health and virtue, gifts
> That can alone make sweet the bitter draught
> That Life holds out to all, should most abound
> And least be threatened in the fields and groves?"

THE PRESS AND FORESTRY

D. G. BICKERS, Associate Editor,
Savannah Morning News

Georgia's State Seals Emphasise Forestry—Hope of Future Lies in Forests—Ample and Cheap Supply of Newsprint Await Development of South's Paper Manufacturing Opportunities—Newspapers' Responsibility to Aid in Education Along Line of Conservation, Protection and Reforestation.

It should be extraordinarily interesting in a significant way that this conference is held in Georgia, the heart-state of the Southeast, in which hope of the future lies in timber in a state which has signed her name officially six times in her great seal with symbols of forestry. Men can interpret signatures. In this signature of Georgia is revealed the thought of the best minds of the state, the core of what leaders were thinking about when the seal was designed, considered and adopted. On every seal of Georgia has appeared a Tree or Trees. Trees on Yamacraw Bluff attracted Oglethorpe to the spot on which the colony was founded in this city of Savannah, mother settlement of the state. We have been in some ways thinking trees ever since; and now we are, by force of circumstances, impelled to be forest-minded. What is important in the development of the state and section is a major concern to the newspaper editors—who get and distribute the news and daily express their views about the news. Georgia papers have more news about forests and carry more editorials about the natural resources as seen in the trees than almost any other one subject, not excepting politics. This is appropriate and wise.

The newspapers are interested in THE big item which for the future has to do with the permanence of prosperity in this section. And it is significant that the words in our language which mean paper or book, and this is true in the Latin, and the Greek and the French and the Spanish and in almost every other tongue, come from old original terms which meant something about TREES or the relation of the trees in smaller growth—like the papyrus reeds. Library comes from the inner bark of the trees. Book is from the same source. The newspaper, the current, daily, universal medium of letter is printed on paper that in the very name comes from the trees. But the newsprint itself is actually manufactured from the pulp from spruce and other trees. And now the spruce supply is threatened; prices are rising; the big supply area is in a region where spruce growth is slow. Here in the Southeast is the inexhaustible supply of a rapid growing tree that offers to relieve us of the burden in Canada—the slash pine. Dr. Herty and the International Paper Company and the state and federal forestry services have been looking into the slash pine, growing seven times as fast as the spruce, as a potential future supply for paper pulp. The solution has been found and more than once announced by authoritative statements in the past few months. The newspapers are interested tre(e)-mendously —get the pun—in timber other than political timber, because in the

forests are hiding the hope of the wealth of this section in future generations; and aside from that unselfish interest there is the intimate dollars-and-cents interest of the solution of the problem of ample and cheap supply of newsprint for their own increasing use.

With such interest, direct and general, in the future of the forests, the newspaper finds a great responsibility in the opportunity to aid in education along the line of conservation, protection and reforestation. Continuing publicity by editorial, news story and special feature will help much in the pine tree area. The Morning News averaged for the past year an original or a reprinted editorial a day on forestry and not a day passes but the news columns carry something to help the cause of intelligent handling of the pines in the Southeast.

CHEMISTRY AS AN AID TO PROFITABLE FORESTRY

DR. CHARLES H. HERTY, New York, N. Y.

Second Growth Pines Do Not Involve Resin Problem in Paper Manufacture—Triple Purpose Pines, Thinnings for Wood Pulp, Naval Stores, Lumber—100,000,000 Acres Available—Rapid Growth Assures Permanent Supply of Material for Paper Mills.

Dr. Charles H. Herty, industrial chemist of New York, native of Georgia and formerly on the faculty of the University of Georgia, declared in his address before the Georgia Commercial Forestry Conference that he is more convinced than ever that the young slash pine is as suitable for the manufacture of white paper as red spruce now largely used for producing news and book paper.

Dr. Herty's subject was "Chemistry as an Aid to Profitable Forestry". He spoke without manuscript, and it is with regret that no provisions were made to report his address in full, an address which is considered gave the greatest encouragement and assurance to the timber owner that his trees are to find a greater and more profitable market in the future than in the past. But Dr. Herty has provided a summary of his statement which is presented further on in this article.

Dr. Herty's epochal discovery that the slash pine up to the time it begins to form appreciable heart wood, estimated at about 25 years, is as free from resinous substances as the red spruce, was announced about a year previous to the meeting in Savannah. He said that the chemical determinations made by A. S. Kloss of the Hercules Powder Company of Brunswick on which his original statement was based, had been checked by analysis made by the Research Bureau of the International Paper Company at Glenns Falls, New York, and the findings had tallied with remarkable exactness. This had added to his confidence in declaring that the young slash pine is suited to the manufacture of white paper.

The statement obtained from Dr. Herty embodying the substance of his remarks before the conference about paper manufacture from southern pines is as follows:

"Four misconceptions have misled public opinion regarding the South as possible center for the future paper industry of the United States.

"First, paper manufacturers have thought of forests of Southern pine in terms of the original forests which once covered the South Atlantic and Gulf States, consisting chiefly of the old trees, practically all heartwood, which once gave to Southern yellow pine its reputation for structural purposes. Such pine is rich in resin and capable of manufacture only into kraft paper. Saw mills have removed the great bulk of these original forests. It is the second-growth forests, the trees in which heartwood does not form until they are about twenty-five years of age, which are the actual material to be dealt with in the present and future.

"Second, because the slash and longleaf pines produce abundant

supplies of spirits of turpentine and rosin it has been assumed that these pines are too rich in resin for consideration other than for kraft paper. Experiments have demonstrated, however, that these all-sapwood pines, prior to scarification for oleoresin production contain but little physiological resin. The actual crop of oleoresin is a pathological product. The question of resin removal therefore no longer exists, and the field is open for manufacture of all grades of paper by any process.

"Third, cattle owners and turpentine operators have annually burned the carpet of wire grass, the former through the misconception that cattle were thereby given better grazing, and the latter through the assumption that burning the woods was the necessary protection for a crop of naval stores. It has not been demonstrated that better grazing is found on unburned land, and the official records of State Forestry Departments show that through timber protective associations, with resultant intensive fire-control, ample protection against fire can be secured at the low cost of 3 1-2 cents an acre.

"Fourth, the states have failed to provide just measures of taxation of cut-over lands where reforestation is being attempted. A healthy sentiment is now rapidly developing for laws which will establish a minimum taxation during the period of early growth of new forests, and until they become revenue producers.

"The rapid growth of these pines, especially the slash pine—about two cords per acre per year—is in startling contrast with the slower growth of northern woods, though from a chemical point of view it is perfectly reasonable and to be expected.

"These pines can be termed "triple purpose" trees, namely, utilization of the thinnings from natural reforestation for pulp wood, then production of naval stores, and finally utilization of the maturer trees for lumber. More than 100,000,000 acres of cut-over lands in the South are available for such development, while further millions of abandoned farm lands can be readily converted into revenue producing areas through pine tree growth. Such abundant and rapid growth assures a permanent supply of raw material for a paper mill, and therefore justifies the conviction that gradually the South will become the natural home of the paper industry."

Dr. Herty said in closing that for a long time, industrial chemists have been centering attention on coal tar products. Now they are turning to cellulose and such significant advances have been made in this field that he had said more than a year ago that we are entering upon the cellulose age. He sketched the progress made in producing nitroglycerine for gun powder, rapid-drying paints, artificial silk, cellophane paper, non-breakable glass for automobiles, artificial leather, etc., and declared that the chemists are opening up almost unlimited possibilities in the use of wood cellulose.

IMPROVED PRACTICES IN NAVAL STORES INDUSTRY

By H. L. KAYTON, Savannah, Ga.

Second Growth Pine Brought Back Naval Stores Production—New Problems Faced Which United States Forest Service Aided in Solving—Improvements in Chipping Methods and Distallation Practices Recounted That Have Reduced Production Costs and Improved Naval Stores Products—Land Ownership Important Factor for Future —Field of Wonderful Possibilities Opening

When the "tar heelers" from North Carolina, after depleting the magnificent forest of long leaf pine which had cradled the American naval stores industry, cut and hacked their way through South Carolina into Georgia, they found a continuation of pine forest growth which to them seemed endless and which, therefore, called for no modification of the ruthless methods of lumbering and turpentining which they had originally adopted. The marvelous specimens of this primeval forest were first "boxed" to the limit—three, four and even five "boxes" being cut deep into the base of these trees,—then bled to the maximum through the medium of weekly chipping or hacking with the old No. 2 hack. After a few years of intensive turpentining, the lumberman claimed his toll and the sawmill was kept busy working up the logs which came to it in an endless stream. Lumber was needed for building and numberless other purposes, cleared land was required for farming and forest devastation was a mark of progress, testimony to the advance of civilization. Why worry about a few thousand square miles of pine forest? There were limitless areas to the South and West. I need not repeat history to you who know as well as I do how, within the course of a comparatively few years, the naval stores business found itself apparently nearing the end of the trail and centered in the last of the remaining virgin fields, the splendid forests of Louisiana and Mississippi.

Second Growth Pines to the Rescue

It was freely predicted that the American crop of rosin and turpentine was doomed to practical extinction and the laboratories of industry using these commodities were set to work finding substitutes therefor. Then came the miracle of the second growth and the discovery of healthy stands of young trees which had unobtrusively established themselves in the cut-over fields; volunteer growths, despite lack of any human aid but, to the contrary, in the face of fire, hogs and other obstacles to successful reforestation. Especially in Georgia did these young forests thrive, and again the sound of the hack was heard in locations which had been abandoned years earlier and declared "worked out."

Experience soon showed, however, that former methods of operation, those applicable to the original pines, were not suitable to the smaller trees. These latter, while vigorous and generous producers, permitted less expanse of face and consequently yielded in lesser vol-

ume than the larger tree. Profitable operation was a problem and producers were not financially able nor equipped nor trained to make the required experimental processes and secure the correct deductions therefrom. At this stage the U. S. Forest Service interested itself in the naval stores industry, recognizing it as the key to the successful reforestation of the southern pine lands. Field men were sent into this territory, studies of gum flow and the effects upon tree growth of various methods of turpentining were made, miscroscopic examinations of the chips and ring growth followed and gradually conclusions were reached that have been of material aid to the turpentine operator in reorganizing his woods work to meet the changed conditions he now faces. Without Government aid, unquestionably the progress made would have been impossible.

Improvement in Chipping Methods

The first and most important advance step in turpentining was the abandonment of the "box" in favor of the cup system. The "box" was a cavity cut into the base of the tree, 12 to 14 inches wide and about 7 inches deep and held about three pints. While not a menace when cut in a large tree, it was not suitable to trees of smaller size as it weakened them at the base and made them susceptible to being blown down by heavy winds. Naturally a "box" close to the ground and containing inflammable material offered a constant hazard during the season of ground fires and to it may be attributed the destruction of many splendid trees. In the French forests a cup system had long before been developed and Professor Charles Herty first caught the vision and advocated its adoption by the American producers. Professor Herty personally conducted a series of field experiments, modifying the French methods to suit the local conditions. As a result, the Herty cup and gutter came into being and rapidly gained favor. The first cup was made of clay and shaped like the ordinary flower pot; it was heavy and easily broken and would not stand freezing temperatures. Galvanized iron was found to be more practical, hence later cups were made from such material, though there are still some operators, usually those working in the lower portions of the turpentine belt and immune to freezes, who prefer the clay cup. Zinc cups have been tried but the material is soft and in case of ground fire fuses too readily. Aluminum is more satisfactory but its higher cost precludes its more general use.

The manner of placing the apron and gutter has passed through various stages of development and there is a great diversity of opinion as to the best method. Originally, installation was made by using a broad axe and maul and placing the apron or gutter in the incision thus produced but again weakening of the tree resulted, as evidenced by the large number of trees which snapped and broke under the pressure of high winds. Especially was this the case in instances where cups had been raised and the apron incision made with the axe. Operators studied this situation and the more progressive ones resorted to the small nail affixing the aprons by tacking to the tree. This change proved beneficial and is slowly growing in favor, in fact, one of the factories will now furnish a flanged apron, one ready formed for tacking to the tree.

Progress in Gum Collecting Methods

There is a great diversity of opinion as to the best method of guiding the gum flow into the cup. Some use the one-piece concave apron, some the two-piece tapered apron, some the double gutter system. There are various modifications and combinations designed to secure the best results and to eliminate waste wherever possible. In the case of raised cups the apron is sometimes moved up upon the scarified face and the chipping carried on from the place of the previous year's discontinuance. In other instances, the operator "jump streaks", leaving an inch or two of the bark at the peak of the face and securing a dam, under which he may firmly set his cup and over which the gum must flow into the cup. This method is considered good turpentine practice since the small area of lost face consists of light wood which would probably have to be chipped away in any event in order to reach live gum producing tissue.

Reference has been made to the No. 2 hack, the chipping tool which was generally used in the earlier days of the turpentine business; this hack ate deeply into the tree, or to use the trade expression, "climbed" rapidly. A streak of 3-4 of an inch or about 24 inches per year pertically was the toll exacted by this hack. Experimentation developed that a shallower chip was equally as effective in keeping the wound open and running freely and that 1-4 inch streak would result in an equal production of gum over a three year period; the tree would be climbed more slowly and as a consequence the face could be worked over a longer period; also, the tree would better stand the bleeding process, remain more vigorous and continue its wood growth at a higher rate. Gradually the larger hack has yielded to the smaller tool until now there are but comparatively few No. 2's in use. The No. 1 hack is probably the most popular but a great many No. 0's and even some No. 00's are in the hands of progressive operators.

Progress in Distillation

Proper methods of distilling the crude gum have not materially changed but through ignorance and carelessness, efficiency had been gradually discarded and bad practices had crept into the business. Kettles were improperly set so that the heat from the fire was not uniformly applied and poor yields of turpentine and low grade rosin resulted; worms, often of too small capacity, failed to entirely condense the vapor and a considerable portion passed from the tail pipe in a gaseous state and was lost; still tubs of insufficient capacity, or not supplied with an adequate quantity of fresh cold water produced a similar loss. The majority of present day operators have eliminated these bad practices and maintain substantial and efficient stilling outfits. Furthermore, they equip their stills with recording thermometers which enable them to run their gum scientifically, rather than by the old sound method and consequently they secure better yields of turpentine and higher grades of rosin. Abandonment of the fire still has been attempted but steam stills have not been successful in operation, though the obstacles to be overcome are probably not insurmountable. Considerable improvement has been accomplished in minor details, such as packing and especially so in the rosin barrel, which has been standardized and made practically

uniform. The old riven stave has disappeared entirely and has been displaced by the cylinder sawed stave, crozed and chamfered, with standard specifications as to length and thickness.

Land Ownership a Factor

Probably the factor which will most likely govern the future of the gum naval stores industry is that of land ownership. Until a few years ago, practically all rosin and turpentine were produced from trees worked under the lease system. The "privilege" was secured for a period of years, usually three, later for four. The only interest of the leases was to secure the utmost in gum flow during the life of his lease, regardless of the effect upon the timber. Naturally abuses were common. Trees were hacked to death; small trees were worked with no regard to their size or vigor and forests were frequently left in condition where the first winter fire practically completed their destruction. Scarcity of timber, resulting in steady mounting lease costs, forced producers to the idea of land ownership and timber raising, the possession of sufficient acreage to justify forest administration with a view to continuous production. This thought has been followed in a number of instances and is working out most successfully. Our native pines lend themselves admirably to this plan, being prolific seed bearers and of rapid growth. Protection against fire is about all they require, other than thinning as the young stands develop. The formation, by individual land owners, of timber protective associations, under State supervision and with Federal assistance, has blazed the way for forest rehabilitation, upon a very large scale. Naturally, the working of one's own timber will be by conservative, rather than wasteful methods; selection of trees suitable for cupping will supersede promiscuous hanging; small trees will be taboo and such will be given the opportunity to develop into workable size; misshapen trees and weaklings will be thinned out in order to give healthier specimens the light and food they require. Survivors will be stronger and more robust and when properly worked will give higher yields of gum and at lower costs.

It seems to me we are just now in a period of transition, that what we have learned is merely the opening chapter of the book and there lies before us a field of wonderful possibilities which in time we shall surely attain.

RESEARCH PROSPECTS IN THE NAVAL STORES INDUSTRY

By DR. W. W SKINNER, U. S. Department of Agriculture, Washington, D. C.

Pine Tree Industry of South Passing Through Period of Evolution—Primary Need Well Organized Naval Stores Industry Willing To Support Research on Which to Develop Future Progress of the Industry—Standards of Products Established—Economies of Distillation Methods Developed

It was with real pleasure that I received the invitation to participate in the program of this convention because of the opportunity to renew personal contacts with the many pleasant and interesting people engaged in the forestry and naval stores industries of this region, and because of the opportunity it affords me to bring to your attention personally some of the research work and some of the accomplishments of the U. S. Department of Agriculture, particularly of the Bureau of Chemistry and Soils, along lines which are of peculiar interest to the several groups brought together here in this convention.

It might be of interest for me to outline very briefly how the Department of Agriculture is organized to conduct the investigations and research made necessary by an expanding and progressive national agricultural policy. The activities of the Department are organized largely on a subject matter basis, under carefully planned and definitely formulated projects. These projects may be allocated to several administrative units, usually called Bureaus, but leadership in a project is assigned to that Bureau or unit which is most favorably situated or most efficiently equipped to do the work. Thus it happens that more than one administrative unit may be engaged in work in a general field of activity, and this is sometimes confusing to those who find it necessary to make contacts with the work of the Department. In order to prevent duplication and overlapping, the research work of the Department is correlated and coordinated under one supervising official directly responsible to the Secretary of Agriculture. This liaison or coordinating official is known as the Director of Scientific Work.

In that branch of agriculture which deals with trees as a product of the soil, the Bureau of Forestry, or the Forest Service, as it is officially designated, has the natural leadership, but several other Bureaus of the Department of Agriculture are vitally interested in a collateral way. For instance, the Bureau of Entomology is interested in insects that attack all plants, including forest plants; the Bureau of Plant Industry is interested in diseases that affect all plants, including forest plants; the Bureau of Agricultural Economics is interested in problems of the marketing of forest products and the utilization of marginal lands; and the Bureau of Chemistry and Soils is interested in the soils on which new forest farming is to be undertaken, as well as the effects upon soils of deforestation. This Bureau also is interested in these technological processes, chemical and physical, which con-

vert the raw materials of the farm or forest into products ready for industrial consumption. The conversion of one of the products of pine tree farming—that is, the raw gum—is the foundation of the naval stores industry, the problems of which are assigned, in the U. S. Department of Agriculture, to the Bureau of Chemistry and Soils.

Thus, in this word picture which I am very briefly placing before you of the activities of the Department of Agriculture, as it applies to the pine tree farming of the South, you see in the background the activities of the Bureau of Chemistry and Soils in relation to the many soil problems involved; then, in the body of the picture, appears the great work of the Forest Service, in forest management, in forest protection, in forest utilization, and in reforestation; and, here, to one side in the foreground of the picture, is the Bureau of Chemistry and Soils in its naval stores work, solving the technological problems of making ready for industry the raw gum of the pine.

The pine tree industry of the South has been passing through a period of evolution, comparable to that experienced by many other industries depending upon natural resources for raw material. This is particularly true of the naval stores part of the industry. Beginning in the South in North Carolina, where the naval stores industry first attained a position of primary importance, this interest shifted, because of the exhaustion of the natural first growth forests, first to South Carolina and Georgia, then on to Alabama and Mississippi, and, finally, to Texas. Now, it is shifting back, with Georgia today again the leading naval stores producing state of the South and Savannah its greatest port. This shift has been in response to definite economic factors, to which the time at our disposal permits only this brief allusion. The return of the naval stores industry to the Atlantic seaboard has been made possible by the remarkable natural reforestation of cut-over lands. This phenomenon has attracted attention to the great possibilities of a rational, systematic effort at reforestation of countless acres of land which are not needed now for general agricultural production, but which are ideally suited for pine tree farming, as is evidenced by the memory of the magnificent forest these same lands once supported.

Pine Tree Farming

I like to use the phrase, "pine tree farming," to define the selection, the planting, the caring for, and, perhaps, the fertilization, the protection, the thinning, the chipping, and the harvesting of the gum from the glorious long leaf pine and its equally interesting slash pine cousin. A rational and profitable development of pine tree farming is dependent, no doubt, upon several factors. One primary factor is, I believe, a profitable, progressive, thoroughly organized naval stores industry, an industry which must apply scientific principles to its daily activities, and which must be willing and ready to set aside a tithe of today's proceeds to provide for that research for fundamental facts that will permit the industry to meet the changes in demand and the utilization of its products which are sure to come with the morrow. In a progressive program of research upon which the future of America depends, the Federal Government, the State Government, the Boards of Trade, and Chambers of Commerce all have important parts to play, but with the industry itself rests a most important obligation to foster and support fundamental research on problems, upon the so-

lution of which it needs no occult power to perceive the future prosperity or, perhaps, the very life of the industry may depend.

The naval stores industry has seen both the opportunity and the necessity. It has created worthwhile organizations which have good leadership and which are doing splendid work. It is bringing together, at stated intervals, producers and consumers to discuss and debate matters of common interest. It is seeking ways and means to expand new markets for its products.

I have said before that I am glad of the opportunity to tell you of what the Bureau of Chemistry and Soils, the unit which I am here to represent, has done and is doing to aid and to stimulate the naval stores industry. While we believe we are able to report some substantial results, this is not done in a boastful spirit. I rather like to think that I am here as an officer in a great corporation to make a report to you as a part of the "Board of Directors" of the corporation. I should also like to say that what we have done is what you and other directors have asked us to do and we have done it to the best of our ability and to the extent that you directors have provided us with the funds with which to work.

Work Accomplished

One accomplishment of outstanding importance to the rosin industry is the perfection of official physical standards which are the outgrowth of experimental work. The fixing of those standards has helped to eliminate trade controversies in the barter of rosin and has removed a baffle that had interfered with the desired easy flow of trade. These standards are now used universally in this country and also in foreign lands. They have been made the official standards in law enforcement regarding grades. A set of these standards, such as I have here, is obtainable at cost from the Bureau of Chemistry and Soils.

Another notable accomplishment is the result of research work on the setting of the fire still, which has increased the yield of spirits and resulted in a material improvement in the grade of the rosin produced. It has made possible a reduction in the cost of operation. There has been an increasing demand on the Bureau of Chemistry and Soils for the blueprints of this set up from those who are building new stills or resetting old ones.

The development of a new type of steam still has been, we believe, a real achievement. This still produces a much higher grade of rosin at a lower cost, as compared with the old fire still. The use of the steam still may mean a change in the handling of the gum so that its introduction, except where larger acreage is involved, may be slow. We believe, however, that, ultimately, the industry will adopt the steam mill as a matter of economy and efficiency.

The Bureau of Chemistry and Soils maintains here in Savannah a Naval Stores Field Station under the direction of Dr. George Shingler, known, probably, to everyone here at this convention. The function of this Station is consultation work and the demonstration of improved technological processes of rosin and spirits production, taking to the stiller in the woods the most approved methods of conducting his operations, such as gum cleaning, still practice, rosin straining, barrel gluing, and proper packaging. The importance of the demons-

tration work lies in the introduction of standardized processes and equipment which permit the production of a uniform product, the lack of which has in the past been a serious handicap in the expansion of the market for the products and has, perhaps, seriously retarded the development of new uses.

At the staff laboratories in Washington, work is being conducted on several important problems, one of which I think has recently been solved by the development of a new type of filter for cleaning gum before it is delivered to the still. This filter, which is of new and novel design, produces really remarkable results. I have here a sample of the rosin from such cleaned gum which I should be glad to have you examine and note its remarkable clearness and brilliancy.

We are conducting research on the various constituents of turpentine. These data are fundamental and may have an important bearing upon the greater utilization of turpentine in chemical manufacturing, such as, for instance, the production of synthetic camphor, which may open up a wide market for turpentine with a greatly increased demand. We are not willing to admit that the last word has yet been said on the synthesis of camphor.

A knowledge of the constituents of rosin also is needed, and can be acquired only by painstaking, time-consuming, fundamental research. The possibilities in this field are tremendous and very interesting to the speculative chemist with a vision of the future of chemical industry. In rosin we have the largest supply of an available, cheap, organic acid that exists ready to be converted into industrial uses when we have developed the technical processes for it.

The needs of the naval stores industry as we see it, are: First, better methods of operation to prevent wastes, which is real conservation; second, the enlargement of research activities for the purpose of expanding the present market and creating new markets for pine tree products. The immediate need of the industry is to so improve its methods as to materially prevent waste, thereby lowering the unit cost of production. I am advised that present methods of operation result in securing, perhaps, only about 60 per cent of the turpentine in the original gum as produced by the tree. Assuming that this is so, it is no compliment to our intelligence or our ingenuity, and is a challenge to our technical science. While practices have been and are being improved, there are losses in the handling of the gum itself from the tree to the still. Undue exposure of the gum by present methods of harvesting is undoubtedly affecting the character of the materials, and may have a profound influence on manufactured articles made from them. An undue amount of foreign matter or a failure to adequately remove it not only affects color but probably influences certain chemical characteristics of the finished products. These and similar problems must be solved by careful experimentation, and then the results of the laboratory must be demonstrated in field practice. The second need is more knowledge, a great deal more, of the products themselves, their chemical constituents, physical and chemical properties, and how the methods and steps of production affect those properties. Then, we must learn how to change those methods so as to meet the needs of the consumer.

Dr. Herty has been vigorously and forcibly preaching the possibilities of pulp wood from southern yellow pine as a factor in a rational system of reforestation, the pulp of the surplus young trees

helping to carry the fixed charges during the time of bringing the pine tree planting into bearing. It seems quite possible that an intelligent scientifically developed naval stores industry depending entirely upon second growth pine may materially aid this desirable result. Indeed, the naval stores industry may be the economic key to the solution of the reforestation problem for southern yellow pine. The problem, I believe, needs to be considered under three major subdivisions: First, the woods operation; second, the handling and processing of the gas; and, third, the development of a definite, well supported research program to ascertain and make available those fundamental facts upon which the future must surely depend, such a program as other large and successful industries have found it necessary and profitable to support. A satisfactory solution of such problems will mean bringing into productive use millions of acres of land, the creation of millions of dollars of new wealth, the employment of thousands of people, which, together with the development of new industries here at home to profitably utilize your raw products, such as outlined to you yesterday by Mr. Oliver, will make a large contribution to the industrial independence of the South.

THE SOUTH AS A FUTURE SOURCE OF PULP WOOD

RICHARD WOODS EDMONDS, Manufacturer's Record

All Factors Considered No Other Area in the World Can Compare With the South as Potential Source of an Everlasting Supply Of Pulp Wood—Nearness to Consuming Market, Abundance Of Good Water, Hydro-Electric Power, Capable Native Labor, Are Other Advantages in Paper Manufacture—Reforestation, Reasonable Taxation And Forest Management Would Increase Supply

When we study the South as a source of pulp wood, the one fact that stands out most conspicuously is that *when all factors are considered, no other equal area in the world can compare with the South as a potential source of an everlasting supply of pulp wood.*

There are two main forests regions in the South—the turpentine pine belt, and the hardwood belt. In a subject as large as this one, and with only 25 minutes of allotted time, it would be desirable to draw a ring around a part of it, and stay inside that ring. However, book and white bond papers are now being made in large mills from the hardwoods of the hills and mountains of Tennessee and North Carolina; and the possibilities those mills represent cannot be ignored. Accordingly, while I am going to draw a ring around the pine belt, it will be necessary for me to step outside of it occasionally.

It is a common saying that all measurement and evaluation go by comparison, and in order to set up a background for appreciation of the South as a source of pulp wood, I want to describe pulp wood production in that section from which comes most of our competition—our own northeastern states and Canada.

In that section the shrinkage of the available supplies of spruce has already forced adaptation of pulping processes to other species of trees; but all species now are scarce in our own states, and the favorite Canadian wood for pulp-making is still spruce, by long odds. Canadian spruce will grow to pulp wood size in from 60 to 80 years—provided it is given a fair start. But where a spruce forest is burned over, or cut over clean, it will not reseed naturally at all. Spruce seeds will not germinate and grow in an open field. In fact, spruce seedlings as much as a foot high and 10 to 15 years old, growing up under a cover of their own species, will be promptly choked off by growth of worthless species if the larger trees are all cut away.

A leaflet published by the U. S. Forest Service describes reproduction of conifers—spruce, fir and pine—in the northeastern states. This leaflet states that "where a goodly supply of reproduction two or more feet high is already present in a forest composed entirely, or predominantly, of the conifers", clear cutting of all merchantable timber will not prevent reproduction, but "where adequate reproduction is lacking a 'shelter-wood' system of cutting should be practiced. By this system one-third to one-half of the stand may be removed in such a way as to open up the stand uniformly and permit the establishment of additional reproduction under the shelter of the remaining trees.

Ten to fifteen years later, when under normal conditions sufficient reproduction will have come in, the remainder of the old stand—which generally will be found to have put on increased growth since the first cut—may be logged."

The fact that stands out between all the lines of this paragraph—and of nearly all paragraphs on the subject—is the amazingly slow growth of those species as compared with our own southern pines.

However, the paragraph I quoted represents reforestation under the most favorable conditions. When land is cut over clean, or burned over, conifers simply will not reseed themselves at all. A paper mill consulting engineer who had a large practice in our own North and in Canada used to describe the cycle of reforestation to me very much in this fashion. Following the cutting or burning over of a spruce forest comes a growth of blackberries, fireweed, pincherries or other worthless species. Gradually, then, comes a growth of deciduous trees, usually birch and poplar. Upon the maturity of the deciduous trees, and in their shade, pine may spread in from a neighboring pine forest, eventually overtop and kill off the deciduous trees. Finally, in the year-round shade of the pines and the spruce from surrounding spruce stands gradually reseeds.

Evidently this cycle must require centuries where any large area is concerned. It has never been observed in full, but merely conjectured from study of different areas in various stages.

As for replanting by hand, spruce nursery stock must be three years old, and must be transplanted in the nursery at least once, before it will be ready to set out in the field. The result is that the planting of a spruce forest in the Lake States will cost from $10.50 to $18.75 per acre. With such a cost to start with, the forester must then wait 60 to 80 years for hand-planted seedlings to grow to pulp wood size.

Compared with this dismal forest picture, southern pine will reseed itself naturally and spontaneously wherever seed trees have been left standing. The young seedlings, if protected from fire and from the razor-back hogs that love their juicy tap roots, will grow to pulp wood size in from 15 to 20 years. Compared with the 500,000 acres or more that are required to maintain a perpetual operation for a 100-ton mill in the North, the area required in our southern pine belt will range upward from a minimum, under most favorable conditions, of 75,000 acres to more than double that area on very poor land.

Thousands of acres of land logged off so clean that nothing was left for regeneration have been planted by the Great Southern Lumber Company, in Louisianna, at a cost, including nursery seedlings, of $3.42 per acre. On smaller and less carefully organized operations, the cost would be higher, but at any figure reasonable for the South, and with 15 or 20 years to wait for pulp wood, compare the cost with from $10.50 to $18.75 and 60 to 80 years in the North!

According to the latest estimates of the U. S. Forest Service, in twelve of the Southern states there is a total of more han 114,000,000 acres of pine area. This includes not only land now in pines, but land that has been denuded of pines and is not now restocking.

There is about 90,000,000 acres of cut-over pine lands, of which approximately one-third is in saw timber, one-third in young second growth, and one-third is not restocking at all.

One hundred and fourteen million acres of land is an area almost

exactly three times as large as the entire state of Georgia. But these figures are for pine alone. "The South Atlantic and Gulf States," says Bulletin No. 1241 of the U. S. Department of Agriculture, "contain nearly 178,000,000 acres of forest lands," and on the next page, "possible growth of pine alone under intensive forestry is estimated at more than 40,000,000 cords a year." Considering all species, it is estimated that the Southern forest growth could be increased by good forest management to over 90,000,000 cords a year. Naturally, much of this will be needed for lumber, but our entire requirements for pulp wood, including imports of pulp wood and of wood pulp, are only about 10 per cent of this total possible production of Southern forests, managed on a perpetual-yield basis. It must be evident, then, that the existing forests of the South, if properly managed, could indefinitely supply all of the pulp wood needs of this country, on top of a great lumber industry, and keep it up just as long as the United States wants to make its paper of wood pulp.

While immense forest areas, large existing stands and a prodigious capacity for growth are the primary factors in making a great source of pulp wood, they are not by any means the only ones. The claim I made for this section is that *when all factors are considered*, no other equal area in the world can compete with the South as a potential source of a continuous supply.

Pulp wood is a bulky, low priced raw material, and cannot stand a high freight rate. In less degree wood pulp is subject to the same limitation. No other like area that can produce as much pulp wood, year in and year out, is so near to great markets or so well equipped with all the other facilities that go to make a great and successful source of pulp wood. Our own Pacific Coast can meet its own needs for pulp wood, but freight rates impose a heavy handicap for competing in the greatest markets of the country. Russia will be able to supply enormous quantities for a time, subject to freight rates for the water shipment and the handicap of slow regrowth. None of these areas can by any possibility reach so large a market, so close at hand; for our own people are the greatest consumers of paper in the world, and the South is, therefore, in a preferred position in regard to markets.

Paper mills require large quantities of both water and power. One of the big and essential advantages enjoyed by the South for paper-making is an abundance of good water.

Further, the many streams contribute to the highly developed, interconnected electric power system that covers the South with a network of electric lines, and provides power anywhere it may be wanted. But Southern paper mills are not limited to central station power. Mills desiring to supply eastern markets settle down along the cost, where they can buy power and ship their product by water, while those desiring to reach the interior markets build further north, near coal fields, and generate cheap steam.

Not paper mills only, but many other industries, have found the untrained labor of the South apt at learning new trades. Tens of thousands of men are existing on farms in the South today because no jobs are available. The great need of the whole section is factories, factories and still more factories, to take up the surplus of available labor, and strike a balance between agricultural output and the local market. Let a mill or factory be opened anywhere in the South, and

the labor flocks in from all directions. Many years must pass, and enormous industrial growth take place, before there can be a situation even remotely resembling a labor scarcity. Transportation facilities by rail, water and highway are adequate and extend into nearly every nook and corner of the area.

But while all of these factors—large existing stands, rapid growth, great markets, accessibility, power, water and labor—make the South the great *potential* source of pulp wood that it is, they will not make it a perpetual source. Throughout, I have been careful to refer to this section as a *potential* source of *continuous supply*, and that word *potential* is packed with significance. Unfortunately, the South is not yet such a source, and only prompt and wise action of the Southern people can make it that. Today our forests are being destroyed much more rapidly than they are re-growing; about four times as fast, the usual estimate is. E. L. Demmon, Director of the Southern Forest Experiment Station, sums it all up in a few words in his last annual report when he says that "although a few forward-looking companies have made a very good start in planning for future forest crops from their holdings, it must be admitted that the timber growing industry in this region is still in its infancy." And he adds, "The various states are helping very materially in furthering the practice of forestry, particularly where state forestry organizations exist."

The various states are helping—yes; but most of them could help a great deal more. They seem strangely slow to realize the enormous values that are so seriously jeopardized by the prevailing indifference and lack of progressive legislation and education for the care and perpetuation of our forests.

I wonder how many of our people have ever seen a vision of what modern forest management could mean to the vast turpentine pine belt of the South? You have all heard discussions of French methods of chipping trees, and French methods of refining the gum—but how many read—or having read, remember,—the description of the French turpentine forests, published six or seven years ago by a committee of naval stores men who went to France and studied the methods at first hand? It presented a striking contrast to our own temporary, crude camps. Exactly as the wood pulp industry of the North has wandered from place to place, and as the lumber industry has done everywhere, seeking fresh forests to destroy, so has done the naval stores industry of the South. In the last few years both industries are undergoing a momentous transformation, not only settling down to cultivate the soil where formerly they despoiled it, but, in the turpentine pine belt, combining to get naval stores, pulp wood and lumber in perpetuity from the same soil. No other section can draw revenue from its growing pulp wood as can the turpentine pine belt—still another reason for the region's pre-eminence as a source of pulp wood.

The American naval stores men who visited France six or seven years back, reported that about 80 years ago the French Government tried a huge experiment, planting pines on a vast tract of land which, under summer suns, was a parched desert and under winter rains, almost a vast swamp. The planting took a good many years, for a large area was involved. As the young pines reached sufficient age, experiments began in chipping them for gum, and the French naval stores industry gradually developed. Its methods today set the

standard for the world. When the Americans visited the region they found, instead of our temporary turpentine camps, towns scattered through it, homes, schools, churches, banks and stores substantially built of brick or stone, and all connected by good highways. They found in brief, that the industry, which, in this country supports its workers in wretched camps with few of the advantages of civilization, there supported them in comfortable homes, where men could live with their families. They reported further, that the people of that section had suffered less from the post war depression than those in any other part of France and were, accordingly, the happiest and most prosperous of the whole country.

While private industry in this country is making some little headway, here and there, toward the realization of small communities like that great one in France, how pitifully far behind what it could be is nearly all of our great turpentine belt!

The states are vexed by the reversion of cutover lands for delinquent taxes; and landowners cannot afford to reforest bare lands unless the area in young second growth at any one time is a small proportion of the total holdings. But a state, with such lands on its hands and no revenue coming in, cannot afford not to plant and cultivate its own pine forests. Much of such land is unfit for anything but pines; will never produce revenue except from pines, and cannot be sold unless the state first makes it salable by establishing pine forests on it.

The subject of forest taxation was assigned to other speakers, and I will not go into it; but it may not be amiss for me to relate an experience I had once, because it has such direct bearing on the development of the South as a perpetual source of pulp wood. Six or seven years ago I was in the office of a consulting engineer—the same one I quoted awhile ago, in fact—and we were, as usual, discussing reforestation and paper making in the South. He took me into his library and handed me a bound volume four or five inches thick of typewritten pages, charts and photographs, and left me to study it. It had been compiled for a large Southern lumber company which had nearly exhausted the timber on its holdings, and had asked for a report as to whether it could profitably go into the paper business, cultivate a perpetual supply of pulp wood on its tens of thousands of acres, and forever settle down to the production of payrolls from land that would otherwise remain idle. The report was exhaustive, and I spent the full morning on it. It listed all the advantages—and a very few, minor, disadvantages. It showed that the lands owned by that company were admirably suited to the cultivation of forests; that the company, with a perpetual supply of cheap pulp wood at its doors, could undersell existing mills in the North and still make a handsome profit. As I read, I grew enthusiastic over the golden opportunities that mass of cold facts and figures set forth. But the last paragraph of that report dashed all my enthusiasm, for the gist of it was that there was just one obstacle to the successful realization of the reforestation program; and that obstacle was archaic forest taxation. Until the tax system of that state should be revised, the report concluded, the lumber company could not afford reforestation.

At least six years ago, that was. Today, on both sides of that state, where more advanced forest tax laws have been adopted, great paper mills have been built. Tens of thousands of acres of pine lands

are under the most careful forest management, and are producing a perpetual source of wealth for those states to tax and payrolls for their citizens to spend. In the state that I speak of, a start has been made in the protection of existing timber stands from fire; a forest department has been created and some sort of a revision made of forest tax laws. But as far as the new tax laws are concerned, they are so half-baked and inadequate that, as the state forester wrote me a few weeks ago, not one acre of land has been listed under them for relief during the growing period from the older tax laws. If that were the only state in the South where such a situation exists, it would be worth while to name it; but since it does not stand alone, I will not point it out. Oh, I know that progress is being made; that state after state has created a forest department, and has set out to protect its forests from fire. But, gentlemen, the progress is so painfully slow. Foresight is the rarest thing in the world in this matter. The New England states are far ahead of the South in their forest legislation—taxation and otherwise; but why are they? Is it because they were more farsighted? Not on your life! They were forced to it, by a degree of forest denudation not yet reached in any Southern state.

In the South, Louisiana is the leader in progressive legislation. Why? Deos Louisiana deserve any more credit than other Southern states for foresight and statesmanship in pulling out in the lead in forest legislation? She does not! With lumbering the great industry it has been in Louisiana for years, no other state in the South has so drastically reduced its forest area. The latest figures I have indicate that only about 3,500,000 acres remain in forests of an original stand of 22,000,000 acres, while about 13,500,000 acres are idle and not restocking. Louisiana had to take the situation in hand. I elieve you could almost lay down a rule that the states with the most progressive forest legislation are the ones with the least forest values left—the ones that are feeling most keenly the loss of forest industries and the reversion to idle lands for delinquent taxes. Why won't the states protect their forest values while they are great? Does a bank dismiss its guards and relax its vigilance when its vaults are bulging with wealth, and guard them jealously only when that wealth has been squandered or stolen?

Lumbermen and paper mills can't cultivate timber unless the laws of the State permit them to make a profit on it. Let the state legislatures do their part, and you can depend upon it, the paper mills and the lumber companies will see to it that pulp wood grows wherever pulp wood will pay a profit.

Sometimes one is inclined to feel that where a legislature is so flagrantly negligent of the state's interest, there should be some way to indict it for neglect of duty; but legislatures are not altogether responsible; to a great extent they must follow public opinion. As long as the public remains indifferent to the values that are being wasted in our forests, we can expect nothing better of our legislatures. It is true enough that no other equal area in the world can compare with the South as a *potential* source of a continuous supply of pulp wood, but those potentialities can never be realized unless the people of the South can be aroused to the wealth they are annually throwing away through indifference, carelessness and bad legislation.

THE WOOD INDUSTRY OF GEORGIA

GEORGE M. ROMMEL, Industrial Commissioner, The Industrial Committee of Savannah, Ga.

Unlimited Forest Resources Await Market Demand—Most Rapid Tree Growth, Herty's Discovery of Absence of Resin in Young Pines and Long, Uniform Fiber of Pines Make Paper Production Inviting—Chemical Research for Larger Use of Organic Acid of Resin Needed in Naval Stores Development—Financing Timber Production on Long Term Loans Sound

I observe several things as I take my place on this morning's program: First, I am the last of a heaping baker's dozen, each assigned at least ten minutes, to some of whom (not me) you would willingly listen for ten hours if you had the time; Second, much of what I might say concerning the wood industry of Georgia has been or will be said as well or better by someone else; Third, instead of tiring you with a lot of rhetorical effort, I might as well jump right to the nub of my remarks, which is the real excuse of my appearance before you and which perhaps may have some of the earmarks of originality.

So, this alleged address will be in the nature of a tabloid summary, the moral of which is that trees grow so fast down here when they have a chance that a man can visualize the possibility of returns from a forest investment within a few years. Therefore, commercial reforestation of cutover lands in South Georgia is a practical proposition which can be worked out by businessmen without interference or subsidies from any kind of government—county, state or national. We do not need the Government to buy our cutover lands to hold for the benefit of a future generation. We do need a market for the forest products which we can grow on them.

The question then, is how and where that market can be found.

From the standpoint of present demand, the timber resources of this region are practically unlimited. There is infinitely more wood in the coastal plain than the wood-using industries, including papermaking, can possibly use.

It is estimated that, within a radius of 200 miles from Savannah, there is enough gum timber standing to supply three times the present annual cut for a period of 40 to 50 years. And gum will reproduce itself in that time.

Within 75 miles of Savannah there are at least 3½ million acres of potential timber lands, lands which will return more money raising trees than any other crop, but which today produce far below their capacity in wood and wood products because they are burned over every year or oftener. And they are burned over because there is no market for the forest products which they can readily be made to produce.

Pine Timber Supply

While the hardwood timber supplies of the Southeast are extensive, they do not fire the imagination as do the possibilities of our pine trees. There is something appealing about a pine which a deciduous

tree does not have. From the time that the young seedling forces its way through the ground, its evergreen foliage holds out to the beholder a perennial promise of use and service, as well as beauty.

We know much more of the reproducing powers of pines than of hardwoods. We know that the rate of growth is much faster than that of conifers of the North. We know this so well that northern foresters think we are exaggerating; they are from Missouri, from Maine and from everywhere else that hardheads grow and think. What we can show them here in South Georgia makes them think things which they never thought before, and that, as you all know, is almost an insult to the intelligence.

Southern Pines for Making Paper

It was only two years ago that we were all talking of the disadvantages of southern pines for paper making. We said that all that was needed was for some bright young chemist to show how to take the resin out of the wood, and all would be well.

I wish to take this opportunity to get myself right and to make a public acknowledgment which is due one of the best beloved and most useful sons of Georgia. I was one of those who shouted about what would happen when the chemist showed how to take the resin out of southern pine wood. I said: "Taking the resin out of Southern pine, so that newsprint can be made of it, is the most important chemical problem in Southern forestry, on which the Southern timber interests could well afford to spend large sums in fundamental research. The chemist who does that will transform the Southern timber industry as Charles H. Herty transformed the turpentine industry twenty-five years ago." It is not often given to one man to effect two sweeping transformations in his lifetime, but that same Charles H. Herty has done it, for he has shown that our whole thinking was wrong in regard to the resin in Southern pine, and that, instead of being resinous as we all thought, the resin is mainly in the heartwood, the sapwood containing no more than is found in northern white pine and spruce. When trees are protected from fire, heartwood does not form in slash pine until the trees are twenty years old or more and have reached a diameter of six to ten inches. Does it need an expert to show what this means, not only to South Georgia, but to the wood-using industries of the Nation? There is nothing just like it anywhere in the world.

Quick Growing Trees and Diversity of Products

Rapidly-grown trees give a quicker return, have a shorter rotation of growth and thus more intensive use can be made of the land, with a corresponding effect on the value of that land; quicker returns from the land make it more valuable to the owner and to the community. Rapidly-grown trees have longer fibers than those which grow slowly; long and uniform fibers are more valuable to the pulp and paper maker. And finally, the trees which we have in mind, slash pines especially, are valuable producers of turpentine—dual-purpose trees, as Alex Sessoms calls them, so that the owner has two sources of income—really three when we consider that the tree at maturity will yield sawlogs—as against one source of income or possibly two in the North.

So let me remind you again that it was a chemist who showed the naval stores men how to avoid the danger of vanishing supplies which threatened them 25 years ago, just as he is now showing us how we can use these southern pines as a source of other kinds of paper than Kraft. The chemist and the chemical engineer are the men who will open up to us the new markets which may be developed for the forest products of South Georgia.

The possibilities of naval stores are no less attractive than those of the wood from which we tap our gum turpentine. And here again the chemist is blazing the way. A simple arithmetical statement shows what service the chemist can perform for this industry.

Outlet for Organic Acid in Rosin

For every barrel of turpentine produced there are more than three barrels of rosin. It will do no good to find new uses for turpentine unless we discover four times as many new uses for rosin. Rosin is said to be our cheapest source of organic acids, containing about 90 per cent abietic acid. Organic acids have an enormous use in industry, but, while pure abietic acid is now being offered on the market, it does not yet appear to have the outlet which is needed to take up the slack caused by "overproduction".

It is significant that the leaders in the naval stores industry appreciate keenly the importance of this matter, and it is still more significant that research chemists are diligently studying it. The Mellon Institute and other research institutions are engaged on various chemical problems which, when solved as they will in time be solved, will do much to stabilize the naval stores industry. The results which have been obtained are still locked up in laboratory files, but it is violating no confidence to say that we may anticipate a great chemical industry developing in South Georgia on rosin and turpentine as raw material.

These two great sources of raw material—pulpwood from sap pine and naval stores—can be economically obtained from young trees, for which the owner does not have to wait longer than 15 years and which, with good management on good sites, he may get in 10 years.

Financing Reforestation

Here, then, is the great opporunity which the cutover lands of the Southeast present to their owners. Their possibilities are already being appreciated by paper companies, and in the complete realization of these possibilities the South will point the way to the development of a constructive reforestation and land-utilization policy for the entire nation. In the cutover lands on which seed trees are standing, the investor may find the possibility of an early return which will attract his capital. The financing of reforestation in the Southeast is simplified by the relatively short time which elapses between seed-time and harvest. If bonds for farm-crop lands are commercially sound, why may it not be possible to work out a plan of long-time financing for the development of these timber holdings?

The idea that the farm will follow the logger on the lands of the Southeast has been tried and found wanting. We must realize that we can cooperate with God Almighty to the best advantage with these

lands when we use them for what they were intended, which is to grow pine trees on them—that there are millions of acres here on which trees will be more profitable than any other crop; in fact that, in many instances, they are the only profitable crop to raise, a crop which can be produced more quickly than in other sections and which can be made continuous, year after year, with the right management.

In working out this development to its fullest consummation, private initiative will lead the way. Only such cooperation from Government is needed that policing and intelligent taxation require and that fundamental research can furnish. With these limitations, on which we should strictly insist, Government should keep its hands off the Southern forests. It is a job for business men.

PRIVATE FORESTRY AS A COMMERCIAL ENTERPRISE

By ALEX K. SESSOMS, Cogdell, Ga.

Settling Cut-Over Pine Lands Proved Impractical—Reforestation Solving Land Problem, Growing 500 to 1,000 Board Feet of Timber Annually Per Acre—Naval Stores Key Industry, Wood Pulp Promising—Pine Forest Investment Better Than Insurance, Safer Than Bonds, More Profitable Than Preferred Stock

Beginning soon after the original pine forests were cut and lasting until about five years ago we had a great problem confronting us known as "The Cut-Over Land Problem." Every land owner whose timber had been cut was impressively reminded each year at tax paying time that he had an apparent asset, which in reality was a liability.

The Turpentine Operator, followed by the Saw Mill Man, descended upon a virgin forest, beginning at Norfolk Va. and extending along the Atlantic and Gulf coasts to Houston Texas. While their operations were in progress the country was a bee hive of industry. Railroads were built, towns were established and every one was prosperous. When the turpentine man worked the timber for three years he moved on to a new location. The saw mill man then began cutting the boxed timber, and when the last log was cut the mill operator usually moved to a new location, taking most of his employees with him, and leaving behind him a deserted, bankrupt, ruined country, robbed of its one great natural resource.

The greatest friend of genuine conservation was the ruthless and destructive lumberman. Because of him it is possible now for constructive forestry to pay dividends.

The removal of the forests not only affected the land owner, but the railroads, the merchants, the banks, and everyone in the adjoining territory. We did then just what we do today, we held meetings; we formed organizations; we grasped at every straw that offered the slightest relief. For several years it was thought the only solution to our problem was to put all the land into cultivation or cattle ranges.

Reforestation Solved Land Problem

Large land owners, railroads, real estate companies and individuals all went after new settlers. Some of us even went so far as to clear land, build houses and offer "ready to go farms". We thought we could settle up this country just as the West was settled by offering inducements to turn the tide of migration Southward to our cut over lands. Many of the large land companies and railroads kept special agents in all parts of this country and Canada in an effort to secure settlers for our lands. Efforts were made to get colonies from Europe; but with all our efforts we made very little progress. The outstanding colonization projects can be counted on the fingers of one hand.

In 1918 there was an organization supported by the railroad known as the Southern Settlement and Development Organization. Its president at that time was the late S. Davies Warfield, President of the Seaboard Air Line Railroad. Clement S. Ucker, its Executive Vice-President asked the U. S. Forestry Service to send a special representative to this section to make a study to see if, and what, the Forest Service might do to help the cut over land problem. Dr. Austin Carey was sent and it was my good fortune to have him come to Cogdell the first stop on his mission. Dr. Carey spent a week with me, the greatest part of each day we spent in the woods and under his tutorship I learned many things about the pine tree that I never knew before. The following winter we began protecting our lands against fire. The first winter we kept about seven thousand acres from burning, in two years we had a stand of slash pine about knee high as thick as hair on a dog's back. Today these trees are from fifteen to thirty feet high, three to five inches in diameter breast high, standing between three hundred and eight hundred trees per acre. In ten years we expect to begin cupping them for naval stores.

Forests as an Investment

The standard dictionary defines forestry as "The Art of Developing or Managing Forests." To be more definite we may say Forestry is the management in the growth and use of forests, which results in a greater continuous and profitable production of timber values than would occur without such management.

Forestry is carried on by two sources, the Government and Private enterprise. Governmental forestry does not have to meet the same acid test that private forestry does. A private forest to be a commercial enterprise, must be a profitable business venture. It must pay expenses of management, operation, taxes, and a fair return upon the invested capital. If a land owner does not profit in dollars and cents by his methods of timber production, he is not practicing forestry.

Private Forestry is not unlike other private enterprises, it has many problems and it requires the same hard work and careful thought. We are to be congratulated on these problems because they are the seeds of opportunity, without which we might not have discovered the greater and better things in store for us.

Location and type of soil are some of the determining factors of Forestry. In this paper I shall consider only private forestry as it applies to the slash pine in the Coastal Plains of the South Atlantic states. It is here that we have a combination of climate, soil, and economic conditions not duplicated elsewhere in the world. It is a unique and limited opportunity. Everyone knows there are breeds of dual purpose cattle, that profitably give milk while growing beef; there are comparatively few people who know of that wonderful dual purpose tree, the slash pine, which will produce pine gum of sufficient value to pay all expenses, taxes and interest on the invested capital while it is growing wood at the rate of one to two cords per acre each year, or stated another way, five hundred to one thousand board feet of lumber per acre annually.

From an industrial standpoint the most promising raw materials for this section are the timber and chemical products of the pine tree.

The returns from a forest for lumber alone will attract some men, but the greater and quicker profits are to be realized from trees which produce chemical products as well as lumber, it should be clear that the Naval Stores Industry is the strategic key to forest growth in this area. For every dollar of profit made from lumber and thinning products of the slash pine, two dollars are made from naval stores.

Imagine a field for conservative investment which definitely can be called better than insurance, safer than bonds, and more profitable than preferred stock. An economic situation now exists in the South which will permit these specifications to be filled. When you read in your favorite newspaper or magazine that, "Commercial reforestation is in actual progress in the South", it means little to you, unless you realize also its potential affects in the financial and industrial fields and that it may have a direct and personal relationship to your pocket book.

C. E. Curran, Senior Chemist, U. S. Forest Products Laboratory, writing recently in the Paper Trade Journal says, "Apparently the South is just entering upon the development of a pulping industry that will make past projects there seem more or less insignificant. To the informed observer this development is not surprising. The only thing strange about it is that it has been so long in coming. Perhaps the chief factor in the delay has been a lack of technical knowledge needed to make the best use of the pulping resources that the South has in such abundance."

Dr. Austin Cary, in an article published recently in the Naval Stores Review, tells of a small grove of slash pine, twenty years old at Starks, Florida; where in 1929 he worked for turpentine 150 faces on an acre and left unworked 114 trees of equal size. At prices which turpentine leases can be sold for, the land owner would realize about $6.50 per acre annually for the lease on these 150 faces, and the volume of tree growth would increase one and one-half cords of wood or 750 board feet of lumber annually.

Diversified Products

Lands reforested with slash pine have four main products to sell, they are:

First—"Land By-Products", such as game, cattle and sheep.

Second—"Thinning Products", such as poles, piling, fence posts, ties and pulp wood.

Third—"Pine Gum", from which we make Naval Stores.

Fourth—"Lumber."

It has been shown conclusively in France over a long period of time, and in the United States by isolated examples over shorter periods, that the growing of turpentine producing trees is a profitable enterprise for the land owner. It is a sound investment returning attractive profits and the land owner need not necessarily wait until his trees reach the age suitable for working because thrifty growing timber at all times has a sale value the same as growing domestic animals or orchards.

I know and you can find out for yourself that raising slash pine trees is a safe, sound and profitable commercial enterprise. There is no danger of overproduction of slash pine, we can not raise enough. Pine trees can be raised with less work and worry than other

crops. They are natural to our soil and climate, and suffer less danger from insects, disease, drought, rain and winds than any other crop, in fact about the only enemy they have is fire, the razor back hog, and the destructive type of turpentine operator.

I know that in raising pine trees I am helping my neighbor who prefers to raise other crops. I am creating a foundation for prosperous industries in my community, I am insuring better fortunes for my children and I am also certain to make safely and easily as much as other people with a like investment but who must take more care and risk.

FARM, FOREST AND FACTORY

AUSTIN CARY, U. S. Forest Service, Washington, D. C.

Southeast Most Promising Region in United States for Timber Production—Outstanding Progress Being Made—Towns in Timber Belt Looking Hopefully to the Future of Profitable Timber Industry—Higher Efficiency and Lower Cost In Naval Stores Industry, Introduction of Wood Pulp Industries in Program of Progress

The topic assigned me is one that has often been treated in meetings designed to stimulate better handling of woodlands, and that uniformly far as I remember, in a way to serve directly the purpose named. For a meeting held at this city of Savannah in the year 1930, exactly that line of treatment, it has seemed to me, would be a bit behind the times, for the reason that the country around us sometime ago started out on the line of advance indicated. A good deal of this has been made evident by papers that have preceded mine, and to residents of the region it is a very familiar thing. For those who have come from further away, and for the wider audience that will perhaps be reached through publication, a brief summary of the facts of the case may be useful. The speaker has been working here as a government man for 12 years past, mixed up pretty thoroughly with these developments.

The region from Savannah west and southwest for about 150 miles has for some years been recognized as one of the most promising regions in the whole United States from the timber production standpoint. Strategic location is evident for one thing; a climate and great areas of soil that favor rapid growth, with tree species among the most valuable, are other factors. Here is the native habitat of longleaf, and particularly of slash pine, those trees from which are derived the greater part of the world's requirement for naval stores. The naval stores industry, as well as lumbering, was extensively conducted on the original growth in this section; then, after its exhaustion and removal, second growth of the same species came on very generally. This in its turn has been worked for a number of years now, to such an extent indeed that the City of Savannah today holds the place which it held years ago as the largest assembling and shipping point for naval stores in this country, and in the world.

Facts of that nature are bound to make their impression on all men, to create an atmosphere favorable to the generation of progressive ideas, or the reception of such coming from outside sources. In this respect too, the region has run true to correct form; I hardly think that any other section of the United States at this time is more generally permeated with the idea of perpetuating industry through timber growing. This idea is taking very substantial forms too, those of primary interest to this audience being fire protection, which is spreading through the country fast today, and numerous business enterprises based on the idea of permanent timber production that have been started. We of this section, therefore, have something in the way of achievement to tell of; in addition, it may be that we have learned some things from experience to date that may with advantage be communicated to others. At any rate these

considerations guide largely in what I have put into this paper.

Farm, Forest and Factory is the topic, *forest* central to the other terms in it. That seems to be a logical arrangement because the forest itself is a natural, fundamental thing, and because forest industry seems, on sober view, to promise to be the largest economic support of this section. By "farm" in this connection I think we may consider that not only actual farmers, but all classes not connected with forest industry are designated. Since then the welfare of all these is bound to be affected by the dominant industry of their section, it is worth while to follow out to some extent relations between them, and particularly to inquire what, if any, favorable consequences have already resulted from the movement in the timber field to which I have just referred.

To do this at all adequately, we must go back a little. The traditional attitude of American communities toward forest industry is that with exhaustion of the native timber it must disappear. That idea held here as elsewhere, was in fact held by leaders in the forest industries themselves only 15 years ago, and by country people apparently much later. The possibility of renewal of useful forest seems not to have entered the minds of most men. Established habits of country dwellers toward fire best illustrate this. Fire on uncultivated land was not thought of as a damage to the country, but as a cleansing agent and aid to stock raising. If it were a question of human activity and encouragement, there would in fact be no second growth in this territory today.

Contrast is suggested with the present condition of things as pictured at the beginning, and contrast there is in fact, though it is easy to exaggerate it. Such exaggeration is not intended, however. The elements of time and degree enter. As for the change from one condition to another, in this respect as in others yet ahead of us, progress rather than revolution is considered to be the natural and wholesome thing. Progress there surely has been, as others have made evident. I will only add that from my own standpoint it has proceeded and seems now to be proceeding at a satisfactory rate.

Timber growing is often pictured as an activity suited to the farmer or small land owner, and it is interesting to inquire how that matter is shaping up in this section. From what has just been said, it must be clear that conditions at the start were not propitious. This also is widely recognized. I think that farmers as a class are not usually alert, quick to change their habits and plans in response to new economic developments.

It is true that here, as elsewhere, once in a while a farmer has realized the value of growing timber, done his best to keep fire out of surplus land he owned, even worked his timber. This is well known too—how, especially further north in this state than the section with which I am chiefly dealing, when the boll weevil struck the country and knocked from under hundreds of men their habitual means of livelihood, bodies of timber that in many cases they did not till then know had value saved them from practical destitution. In the turpentine belt of late years, the small land owner has been getting more and more out of his timber by way of lease; in some cases the amount of this revenue has surprised him; naturally that fact is changing his attitude toward his own forest land and toward the timber growing idea as a whole. All of this is to the good and what is to be expected. It cannot be said that farmers and small

land owners are as a rule living up to their opportunities yet. Certainly they are not leading in the movement on foot; that part is being taken by progressive operators and large owners of land.

Another very interesting question arises—whether this movement for timber growing is having any effect on communities as a whole. Time enough has not yet elapsed for that to show up strongly, but I think the tendency is to be seen. With absorption of the idea that their naval stores industry is not doomed to early extinction, but promises to be permanent and very likely to reach a development that it never before had; with thought also of the upgrowth of other industries based on the forest; with the turning of man's mind into broader channels like chemical research as related to their business and markets for their products in all parts of the world, men have been expanding, broadening, and some of these South Georgia towns have been picking up, respecting themselves more, improving living conditions for their people. Illustration tells in a thing like this, and no odium should attach when comparison is not intended. Homerville in Clinch County, a town that for some years, with a degree of pride apparently and certainly with considerable justification, has been calling itself the pine center of the South, is today a very different place to visit than it was a few years ago.

The final term in my topic is the "factory". By this is doubtless meant in the first place, the turpentine still, the saw-mill, manufacturing plants of any description. We all understand how important these are, to the producing section for the employment they furnish and the returns they bring in, to consumers as well for service rendered in fitting to human use the raw material provided by the forest. I think also that one can logically treat under that head industrial developments in a general way and external or marketing relations also if sufficient reason appears for doing that.

The idea with which I began this portion of my discourse may seem a strange one for a forester and a government man to formulate; it is this—that it is not industry alone and unqualified, but **profitable** industry, that benefits a country. It may be well to dwell on that a little, but it ought to be evident enough when men consider it. Industry of any kind is human effort fundamentally. That should be rewarded, to the extent of tolerable living conditions for workmen and returns that enable reasonably efficient business men to continue and expand; otherwise it fails of its true object.

The above is sufficient on the philosophy of the matter, I am sure. I will go on now to recount some observations and deductions of my own, fortified, however, by long, intimate and friendly association with the people directly concerned.

We may go back again to the state of mind long holding in this section and the country at large in respect to our forest resources. Periodically since 1880 at least, predictions of timber famine have been made, and it is true that in the country as a whole virgin timber has been disappearing fast, while from time to time conditions in the lumber markets have been in evidence that gave more or less color to the idea. However, incidents have also occurred of another sort. Take a specific example from my own country, New England. Ten years ago in that territory and lasting for a period of about eight years, white pine lumber brought prices higher than ever before, and the demand could hardly be supplied. Stumpage, too, went up

to high figures; it seemed clear to a lot of us that to raise timber ought to be a highly profitable line of business. Today, however, as for five years past, conditions are of an entirely different sort. One trouble was that our prices got too high; it was too good to last; West Coast lumber and boxes made of fiber and veneer replaced our products in the markets, stumpage owner and lumbermen alike being deflated.

That is one case; numerous others could be cited. It seems appropriate here only to refer to a set of events more or less similar that has worked out during the last ten years in the territory we have under review.

Just ten years ago, men's ideas about the future of the naval stores business as dependent on its raw material came to the surface through a government publication. The outlook pictured was gloomy indeed; there was no future worth speaking of; by this time in fact timber available for the purpose was to be practically at an end. Vastly different however has been the course of actual events. For one thing the process of procuring naval stores from fat stumps and top wood has been perfected and a large volume of production built up in that line. But in the other field the forecast was wrong utterly. There was more timber in existence than men thought and growth in the country was greater; also the results of studied, intelligent operation proved far greater than men at the start would have thought in the way of producing more gum from the tree. As a result of all these developments, for the last three years crops of gum naval stores among the larger ones on record have been put out, and while the world has absorbed them, prices received have been low, not enough to keep the country comfortable; and no relief is in sight for the present season.

Normal men regret these things as far as they do not represent necessary adjustment to industrial change, working for higher efficiency and lower cost perhaps. The point that I am especially concerned to make on this occasion is that conditions of the kind indicated interfere with and limit the effort and expenditures we are so anxious to have put out in the way of developing our forests. Take fire protection for one thing; that costs some money, particularly in a section under handicap just starting out on that line. Take thinning also, a cultural measure that men are just coming to understand, when applied to young turpentine timber is hardly less productive. In cases with which I am personally familiar, it is halting today, because income is not available to meet the expenditures involved.

What are fair and useful inferences from all of this? Not certainly those embodied in words by a couple of men it was my own chance to encounter—one saying that if government workers had left them alone, operators would now be getting a dollar and a half instead of less than fifty cents for their turpentine; the other, that he would contribute to any common project except fire protection, because there was too much timber in the country already. The true lesson, it seems to me, is moderation, patience with this territory, to realize that soundness of financial and industrial structure is essential to the interests we have at heart, understanding and sympathy as men in different ways go about the task of strengthening that structure.

To come to matters more directly in line with the interests of this audience, I may mention in the first place the judgment of the best informed men, as to future volume of the naval stores industry. That runs to this effect—that while there may be temporary shortages of supply, there need in a general way be no apprehension. A vast resource in stump and top wood is available in case of need. Of standing timber also, a large amount is in existence, promising, it is thought, a greater abundance for the somewhat removed than the immediate future. A step that the industry is today taking of its own motion should help in this direction, as well as toward securing better returns, limitation of the size of trees to be worked.

As evidencing alertness and progressive outlook in this industry, I may mention things now going forward within it or under its auspices,—chemical research started in the hope of finding new uses; fundamental inquiry into methods of manufacture that may conceivably result in radical change; trade organization shaping up as a means of backing the research in part; an inquiring state of mind in respect to marketing methods.

Note of the reaction of the industry and region to specific features of what is usually called forestry, will be of especial interest to some. Here I feel myself that the situation is promising. We have heard already of fire in this relation, but men are going, or getting ready to go much beyond that—at least that is true of significant leaders. In this field of forest management, the French are our patterns in a way, and following their ideas, but with modifications adjusted to our own conditions, a system of this kind has just lately been worked out, technical and practical men co-operating. This I expect to see applied as fast as it proves out and is called for.

The features characterizing this proposed system lead to the formulation of other ideas. First, the plan of management framed up involves, in addition to working for naval stores, the outturn of great quantities of timber of rather small size, not well suited to sawing, but on the other hand ideal for the use of paper mills and for other somewhat similar uses. This seems to me true and the most significant point in the field now entered—that this section of the country, given inducement to do so, can produce pulp wood in vast quantity at lower cost probably than any other section of the United States. The paper mills in their extensive migration to the South have so far skipped us in this section. They may have made a mistake in that. It seems to me they have, and that in all reasonable likelihood they will soon rectify it.

Secondly, it looks to some of us as if, along with production of naval stores and small timber, and rendered all the easier because of these outlets, the production of saw timber also is likely to be a feature of forest management here. The technique of this business I cannot recount now, but will say that it has been worked out on paper, and that sufficient inducement in the way of market and price is the most we seem to need. That statement may seem strange to some, but it is literally true to the best of my belief and judgment Of course, we understand that unfavorable conditions may be temporary; men I know would be thankful indeed for information of a broad and fundamental nature on which they felt they could place reliance.

With that the time allotted has been used probably, and it only remains to emphasize a few essential points.

I think it can be said with confidence that the world need have no concern over future supplies of naval stores on the scale it has hitherto required, at prices no greater than it has been accustomed to pay, nor the United States as to its future predominance in this field. In fact, the forest lands of the Southern States can very readily be made to produce crops several or many times as large as they ever did.

Vast quantities of bled out timber suitable for paper making and numerous other such industries stand in this and neighboring sections today, cumbering the ground mostly available therefore at a very low price. The supply can be perpetuated, promises to be, as a by-product of naval stores production. No section of the country, it is thought, promises to provide cheaper pulp wood.

Out of and along with these lines of production, that of saw timber should grow naturally as well—will in my opinion do so unless sufficient inducement fails. Again, in this field also, no section of the country stands in better shape to compete.

To say these things involves a degree of faith—that there is no denying. That in the present instance is in the first place faith in a country, and secondly, faith in men. These last are in part those of the immediate locality, owning its lands, conducting its industries, performing its labor; in part also our general citizenship here and elsewhere. These last enter the picture at various points, most evidently in connection with taxation, protection, and in the various ways in which law and community behavior may affect enterprise of this sort. These matters have been developed by other speakers; the promotion of advances in these lines I understand to be the chief purpose of the present congress.

HIGHER RETURNS FROM TURPENTINE FORESTS

LENTHALL WYMAN, Southern Forest Experiment Station, Starke, Fla.

Proper Cup Adjustments, Regularity of Chipping, Greater Frequency Of Chipping in July and August, Removal of Foreign Matter From Cups, Location of Faces on Sides of Trees With Greatest Limb Growth Avoidance of Placing Cups Above Fire Scars, Lower Chipping of Trees, Narrower and Shallower Streaks, Working Trees In Excess of 9 Inches in Diameter, Thinning Over-Crowded Stands and Fire Prevention Will Bring Higher Returns to Turpentine Operators

Higher returns from turpentine forests may be realized from elimination of wastes, intensive working methods and a gradual building up of the woods which will bring them into greater productivity.

It is recognized that many wasteful practices are employed in handling and stilling of the gum but these are outside of the province of this paper which will be restricted to the production of gum in the woods.

Practically every operator is familiar with the many forms of waste which occur in his woods. Therefore, this phase of the problem of obtaining higher returns from the turpentine woods will be only touched on very briefly. In the aggregate the gum which is wasted in the woods is a considerable factor.

First there are many leaning trees on which the cups are so placed that they do not catch the gum which is produced. These trees are frequently in need of having short side tins inserted at the shoulders of the face to guide the gum into the cups. Flat cups are frequently set in such a way that it is necessary to tip them at a sharp angle in order to remove them for dipping. If these cups are full of soft gum such as is produced by slash pine timber during the hot summer months some is apt to spill out. Very frequently careless dippers replace cups in such a way that they fail to catch the gum on this account.

Another common form of waste comes from a failure to change cups promptly when they are full. Some operators report that many high yielding trees in titi thickets are not chipped regularly because of the brush.

The obvious remedy is to have more careful supervision in the woods. Closer inspection will eliminate most of this waste. To get this inspection it may be necessary to reduce the size of the "ride" from ten crops or so down to seven or eight and to give increased duties to the woods rider. He would then have time to fix any loose aprons or gutters. He could also give closer supervision following dipping to see that the cups are properly replaced on the trees. By reducing the amount of territory covered by the woods rider it would be possible for him to cut out paths to trees frequently missed be-

cause of their occurrence in dense thickets and therefore make it less likely that the chippers would miss them. The increased cost of such work would be justified by a saving of 2% of the gum production.

There is a great deal of variation in the matter of carrying paddles to cover the cups and exclude chips and trash at the time of chipping. The amount of chips and foreign matter in the gum as it reaches the still varies between 1 per cent and 3 per cent by weight and even more than this by volume since the chips are lighter than the gum. Not only does this trash soak up rosin in the process of stilling but also the operator who has a large amount in his gum is paying for trash which is not only of no benefit to him but is even a positive detriment. Here again close supervision and a strict insistence on the carrying of paddles are the obvious solutions which suggest themselves.

So far the points discussed have been ones which are usually recognized by operators. The next point for consideration is one which may not be so generally appreciated. It deals with the marking of timber in advance of facing. It is believed that this is a field which offers a possibility of large returns.

The proper location of faces on the tree is an important item. It has been shown by experiments that trees with eccentric tops produce more on the side of the tree which has the largest branches. Frequently trees which are growing close together so that the branches have been shaded away on one side yield very poorly when faces are placed on the side with no branches. Many of our trees have been scarred by fires in the past and faces placed above these fire scars are poor producers which almost always fail to yield as much as they would have if there had been no interference with the flow of sap by the fire scar. The proper location of faces can be designated by paint marks or blazes put on by the woods rider in advance of the facing. At the time any trees which are obviously poor gum yielders can be eliminated and a strict adherence to the minimum size of tree which will be faced can be observed.

In order to get the most out of the trees it is essential that they be worked intensively when they are yielding at the maximum. In the summer time turpentine faces cease to yield after about the third day or at least during the last four days of the week is such a small factor as to be insignificant. It is fairly obvious that chipping twice a week during July and August should be productive of higher returns. In the past there has been some question as to whether the timber would not be hurt by such practice. Some of the early Forest Service experiments showed the expected increased yields from double chipping but they also showed a considerable amount of damage to the trees so treated during the second year of operation. However, this test was conducted in old growth yellow pine which is much more susceptible to damage than the younger stands of trees which make up the bulk of our turpentine woods today. Some experiments have been carried on by the Southern Forest Experiment Station in the use of frequent chipping in order to get high yields from second growth pine. Although these tests were confined to a few trees and may hardly be termed conclusive yet they do indicate that short chipping intervals may not be as injurious to the timber as the former experimental work indicated.

In the late fall and early spring when the weather is cold the situ-

ation is quite different. Our experiments have shown that trees continue to yield for 10 days to 2 weeks or even longer when low temperatures prevail.

Therefore a two-week chipping interval should be allowed during cold weather at the beginning and end of the turpentine season in order to get the maximum production from the streak. There has been considerable discussion in the past about the desirability of prolonging the chipping season. The conclusion reached by the Southern Forest Experiment Station is that winter work is not injurious to the trees although it is doubtful whether a streak put on during the cold weather will be as productive as one made in July or August even though the trees are allowed to run for two or three weeks during the winter. In the long run winter work is apt to be poor economy.

Although the general tendency on the part of turpentine operators today is toward the practice of low chipping, nevertheless a great deal more can be done in this direction and by the practice of lower chipping greater returns may be realized from the timber. Some of these returns are direct and some of them more or less indirect. For instance, although wide streaks have been shown to be more productive during the first two or three years of operation than narrow ones, yet over a five-year period narrow streaks have been productive of as great a yield as heavier work. After a face reaches a height where it is no longer possible to raise the tins the yield falls off rapidly. This point is reached in 3 or 4 years with the current practice of chipping 1-2 inch streaks. With narrower chipping it will be possible to chip for 5 or 6 years before the face is so high that cups can no longer be raised. By using low-chipping methods it will be possible to use a hack for 5 years before changing to a puller. Furthermore, by increasing the working life through low chipping and by using narrower faces it is possible to work fast growing timber practically continuously.

The naval stores leasing value of the timber is of course increased by increasing the number of working years. Since most operators are also timber owners this means an additional asset to them. Finally by working the timber continuously it would be constantly under fire protection and the fire damage which has been almost universal on old abandoned faces would be avoided. The trees would grow faster and heal in over the old faces more rapidly and back faces yields would be improved.

The practice of a conservative depth of chipping ranging from 1-2 to 3-4 of an inch will be productive of higher returns in the long run. The proper depth of chipping is dependent upon the width of sap wood in the tree. Trees with wide sap rings stand much deeper chipping than those with narrow growth rings and narrow sap wood caused by growing under crowded conditions. It has been found in experimental work at Starke that chipping in excess of 3-4 of an inch in depth increases the amount of damage considerably. Many more trees dry-face and there is a noticeable increase in the number of trees broken down by the wind. Furthermore, the growth of the trees during the chipping period is cut down more by deep chipping than by shallow work.

The elimination of close cupping should also be productive of higher crop yields. Dr. Cary and others have shown that the yield per face is reduced by working two faces concurrently on trees ranging from 8" up to 10" or 11" in diameter. In fact in some cases the

total yield from small trees with two faces has been lower than the yield from other trees of the same size carrying only one face. Furthermore, it is recognized that the production of turpentine trees is determined primarily by the size of the tree. During the past months the desirability of confining chipping to trees above 9" in diameter has been emphasized and this undoubtedly is the most important step that could be taken by turpentine operators today to obtain higher returns at no increase in cost of production. During times of low prices for naval stores products such as are prevailing today it is important that all trees which are being worked shall be large producers. The cost of operation of 10" trees is no greater than the cost of working 7" trees, yet the larger ones will yield practically twice as much as the smaller.

Timber owners should take steps to improve their forests. Experiments carried on by the Southern Forest Experiment Station show that the best type of tree for naval stores purposes is a large crowned fast growing tree. Such trees can be obtained by thinning stands which are overcrowded so as to provide plenty of growing space. Fires are injurious to tree growth. They defoliate the trees in some cases and reduce the fertility of the soil whenever they occur. If tree growth is to be kept at a maximum they must be excluded. Fortunately, this is becoming an easier matter every year until today the State Forestry organizations stand willing to assist land owners in eliminating fires with every prospect of success.

It is believed that by reducing waste to a minimum, by practicing conservative chipping, by avoiding close cupping, and by eliminating low yielding faces the number of crops will be reduced and the average crop yield will be raised. In this way the problem of getting higher returns from the turpentine woods will be met.

FOREST MANAGEMENT ON THE SATILLA FOREST

By E. A. STERLING, Vice-President James D. Lacy Co., Jacksonville, Florida

Large Concern Bought and Managed Forest to Produce Poles—Complete Forest Survey First Essential to Forest Investment—Response of Young Growing Timber to Fire Protection and Thinning Remarkable

The Satilla forest is intended as a business investment. Its primary purpose is to grow timber for poles as a permanent source of supply for the local creosoting plant of the owner. It is also part of the economic picture, that the forest produce enough revenue from the salvage of merchantable timber, by-products, and turpentine operations to carry it while being brought up to capacity production.

The Georgia Creosoting Company as a subsidiary of the American Creosoting Company faced no immediate problem of pole or general timber supply. The potential producing area tributary to the Brunswick plant is some 85% forested land, with streams, railroads and highways which provide transportation. Local contractors deliver poles and other material at the plant, and with over five million acres of second-growth timberland to draw on there was an evident over-abundance of small poles for an indefinite time. The only indication of shortage was in large poles, long piling, and large dimension timber. At the same time, it was apparent that the pole supply must come from available timber in general demand by other consumers.

The executive head of the company was not satisfied with the existing conditions. His concern was not with the next five or ten years, but as protection fifteen, twenty, or even more years ahead he visioned the changes likely to take place and the need of at least a neucleus of company timber of suitable size and character to serve as a reserve supply. Turpentining was everywhere retarding the growth and reducing the quality of the second-growth longleaf, piling contractors were seeking out the larger pine of all species, tie cutters were supplying their market, and the steady drain for various purposes might at any time be increased by pulpwood production which would take the timber before it was large enough for other uses.

Various factors contributed to the conclusion that dependence could not be placed indefinitely on a satisfactory timber supply from the diversified holdings of the many local owners. In riding through Camden County one sees little except second growth timber, but closer study shows that general appearances are misleading. Some 80% of all available properties are being turpentined, in many cases down to a diameter of 7 inches. The average tree when completely worked for turpentine will be 9 inches D. B. H., and have two or three old faces 7 or 8 feet high. Such timber will make D and E poles only and are so slowed down in growth that they hold little future promise. Larger timber is found only in the swamps and branches, and without protection and management most of the small

timber which dominates the landscape will never be much more than it is now. Another factor is that local ownership is unstable and as tracts change hands, each owner tries to liquidate enough of the timber and naval stores to make a little profit. The result is that most of the properties are continually depreciating rather than improving.

The present Satilla Forest comprises about 24,000 acres in two main units. In selecting these lands several fundamental requirements were kept in view. Two major site conditions represented by the pine flat woods along the coast and the pine uplands further inland were recognized. The desired combination was good growing conditions, a reasonable amount of natural reproduction, and enough commercial timber to yield a revenue during the development and improvement period. The "crawfish" type of pine flat land along the coast was avoided because growth conditions are unsatisfactory and there is more swamp than on the better drained lands represented by the pine uplands. Transportation is also important in relation to both streams and highways.

Longleaf pine is the most important tree from the standpoint of volume and quality, and since young growth of this species is exceptionally fire resistant it has, as a rule, seeded in on large areas where all other re-growth has been killed by fire. Of equal importance, and encouraged wherever possible, is the slash pine which, with longleaf, are revenue producers for naval stores as well as timber. The remaining species are loblolly and pond pine, the gums, ashes, cypress, and other species of the swamps.

The first step in forest management or in acquiring lands for this purpose is a complete forest survey and inventory. This is usually called for prior to purchase in order to arrive at a basis of value and determine the suitability for the purpose in view. This was the procedure on the several units of the Satilla Forest and was followed by more intensive study of growth and yield. From all of the data, including a forest map, a management plan was prepared which outlines a production and improvement schedule so that each year's operations are budgeted and carried out under a definite program.

Forest management in the Atlantic coastal pine region is essentially systematic protection and production. Protection from fire comes first and is attained by the usual methods of look-out towers, patrol, fire lines, and education. Its importance cannot be over-estimated in establishing a capacity stand of regrowth and in increasing the rate of growth of timber of all sizes. The importance of fire protection is so well appreciated that it needs no further elaboration.

Production represents both volume accretion by new growth and conversion of timber ready to be cut. The first has almost unlimited possibilities, and one of the most stimulating and encouraging phases of a management program is the increase in the productive capacity of the land. The aim of the forester is the normal forest, but to the operator the appeal is a maximum stand on which 200 or more cups can be hung to the acre instead of 30, or a lumber yield or its equivalent of 25,000 to 30,000 feet per acre instead of 5,000. The first means to this end is to have the land fully restocked, and the second and one of the most important aids that can be given to nature is proper thinning so that maximum growth without stagnation from root and crown competition can be obtained. The response of young

growing timber to fire protection and thinnings is little short of remarkable, but we as yet have no complete figures covering this because so few areas have been protected and handled in this way.

Production from the standpoint of utilizing material now on the ground is both an important measure and an early source of revenue. The progressive owner and the conservative operator should be able to go much farther than the average owner in utilizing both major and minor forest products, and on the Satilla Forest there is a distinct advantage in having a creosoting plant as an outlet for certain classes of material.

In southeast Georgia turpentine operations are an important phase of management and on many properties the largest source of revenue. Old face trees which will carry another face can be worked several years and then removed, while round timber under the present program will not be turpentined under 9 to 10 inches, and then only by conservative methods which permit a long working cycle with a maximum damage to the trees. These improvements are carried right on through to the still for the purpose of increasing both yield and quality.

On the Satilla Forest and many other favorable locations in the coastal pine belt extensive areas are already well restocked. This brings an earlier financial return and results can be shown without waiting a long period of years which tends to lessen an individual's interest. The natural regrowth 10 or 15 feet high or 3 to 6 inches in diameter has already got a start of 10 to 20 years so that even a 10 year period brings about a marked transition and improvement in the character and value of a well managed and protected forest.

It has been found that early liquidation or conversion of the merchantable timber is desirable in order to reduce the capital investment and cut down the carrying charges. Well selected, cut-over pine land with 1500 feet of merchantable timber remaining per acre and good reproduction in various stages should carry itself. In any event, it is in the future that the substantial results from management will be attained and no one should undertake it without a long time viewpoint.

There is a much larger picture in which the Satilla Forest and similar projects appear against a very broad background of diversified conditions and influences. If the conception of commercial forestry as applied in these cases is correct, these industrial forests will serve as examples in pointing the way to a better use of extensive areas of cut-over pine land in the southeast. There will likely be a difficult transition period during the next five or ten years, but if the present regional competition, over-production and other complications serve to bring about stabilization of the forest industries, much greater encouragement will be found for commercial forestry.

The universal use of wood will certainly continue, with adjustments and changes which should ultimately favor the producer. Whatever these changes may be, it is reasonably certain that a highly productive forest in a region of growing industrial activity and with transportation outlets to centers of consumption will be a desirable and profitable investment.

TAXATION AND FOREST ENTERPRISE

J. LEONARD ROUNTREE, Summit, Georgia

Agriculture Without Forest Products Not Self-Sustaining—Forests Solution of Abandoned Farm Problem in Georgia—Tax Relief Essential as Reforestation Takes Place Under Organized Fire Protection—Tax Deferred to Time of Harvesting Advocated

To those who have been associated with the Forestry work since its inception, and others, this meeting has been of inestimable value, will produce wonderful results, add interest and renew courage to reestablish forestry, not only in our state, but in this entire section.

We wish to extend again our heartfelt appreciation of those who have come from a distance and outside of the realms of our own commonwealth, and by their wise counsel, experience and training, have materially aided us—and to beautiful Savannah, made famous through the natural beauty of her original forest parks, noted for her hospitality, which was made secure forever, right after the battle of Manilla, when in a burst of patriotic fervor unequalled in any city in these United States, its people welcomed Admiral Dewey and made him feel at home.

It has been only a short time since we created the Forestry Act after four years of untiring effort. Just to realize the interest now manifested in forestry, as compared with then, I remember Hon. B. H. Stone, myself and others, as a delegation asked the late Hon. M. M. Parks, then State School Superintendent, to adopt a course of study on forestry in all the schools of the state, and so far as I know this was the first effort in Georgia to demonstrate and teach to the youth of the state the great value of forestry.

Your committee has asked that I say something on Taxation and Forest Enterprise. While this subject could be dwelt upon at length, I shall only make a few remarks without attempting to cover it.

Let us go back, if you will, to nearly two hundred years ago, when Oglethorpe landed on the bluffs of this now beautiful city, and vizualized the magnificent empire that stretches to the Pacific Ocean for the greater part covered by the most valuable forest the world has ever known.

Immediately, after landing and settling this country, the inhabitants began denuding the forests and converting the land to agricultural usage. This spread all over the state and enlarged until now there are only a few tracts of original forests left, and we are met here today to try to devise some plan and create an interest that will in a way re-establish our much abused, much wasted and more often fire-destroyed forests. The forests of Georgia were the almost direct result of her development, more especially in this part of the state, because practically all of the railroads of this immediate section were constructed primarily to remove forest products. Agriculture, towns, and manufacturing enterprises followed as natural consequences.

Without digressing, let us look at agriculture as allied with forestry. Right here I am going to make the astounding statement—realizing that you may not agree with me—that agriculture in this section without the aid of forest products has not been self sustaining.

In line with this statement, without knowing the latest statistics, we have to point out only that there are in Georgia today 55,000 abandoned farms, and to those who have read the census figures that are being released, you will be compelled to arrive at the conclusion that this enormous number of abandoned farms in Georgia will be increased further, and from a taxation standpoint we can readily see that we are losing enormous revenue, potential and real, from those abandoned acres. Add to that five or six million acres of cut over lands in this state, most of the growth being retarded annually by fires and you have a problem of a large percentage of the available area in Georgia non-productive.

This situation, coupled with the question of taxation, is the problem that we are faced with today. Another feature that confronts us is that despite the present slump in forestry products, we are imposing an enormous tax on not only the present, but the future generations, because they will have to go into distant markets to purchase their lumber and other forest products, paying enormous profits to those who are fortunate enough to have them for sale, high freight rates to transport these products, and last but not least, probably these products will be of an inferior grade to what we could grow ourselves. This might not be considered from a taxation standpoint, but it most assuredly is.

What, then, is the answer to the question of what we are to do with our devastated farms, and our cut-over areas? We have just stated that there are over 65,000 abandoned farms in Georgia, this being more than any other state in the union has and is about 75% of all the farms abandoned in the United States. We see by the present census reports daily confirmation of the drift of the rural population to the cities. We know that this is caused by the fact that farming, within itself, is unprofitable, our farm products bringing less than the cost of production. Therefore, our inevitable conclusion is that our best remedy is to go back to nature on these abandoned, cut-over, and devastated area endeavor to re-establish our forests, knowing that they will pull us out of many financial situations just as they have done in the past. But to do this, the owners of these lands who are now compelled to pay high ad valorem taxes on them, although they may not be producing one cent of revenue with which to pay these taxes, will be compelled to have some assurance from the state that they will not be penalized if they should attempt to grow forests by any method, because we all know we cannot grow these trees overnight, but that it takes time and care, and ever watchful vigilance to keep fires away.

After careful study, we know of no better plan than the proposed Forestry Contract Act that was offered by us in the legislature some years ago. One of the provisions of the Act provided for stabilization of taxes on the land proposed to grow forests, and in my opinion, the State of Georgia could pass no wiser law than to exempt from taxation entirely, her lands for growing timber for the period of the contemplated growth. If we can not do this, then let us insist that our representatives pass a law that would make one safe in the investment of growing timber by the provisions of the Forestry Contract Act. We propose that where a landowner had a tract of land that he wished to set out to timber, or protect it from fires by patrols, that he and the County Tax Assessors should agree on a stabilized price per acre for

this land for the period of time it took to grow a crop of timber, agreed on between the assessors, the land owner, and the State Board of Forestry, operating with, or without, connection with the Clark-McNary Act and that the taxes on this land should be agreed upon as to the price per acre. After the timber has been grown, and after it has been sold, the revenue derived therefrom then certain percentages of the price received for the sale of the timber should be paid to the state, counties, and schools, as a part of the accrued taxes while this timber is still growing, but from which no revenue had or could be derived until sold. There are other provisions, but in the main, this is the gist of the act. While there may be other plans for growing timber, we know that from a business standpoint, very few are going to invest any large sums of money in timber re-growth with the almost certain knowledge that just as soon as they get timber growing someone will come along and put a prohibitive tax on it, although he may have been spending enormous amounts of money on his timber crop for a period of years and yet not having received one penny in return for it.

CONFERENCE RESOLUTIONS BRIEFED

NAVAL STORES RESEARCH

The United States Department of Agriculture is urged to establish at the earliest possible date a naval stores experiment or research station under the direction of the Bureau of Chemistry and Soils, to investigate the proper methods of handling and stilling crude gum, rosin and turpentine.

REFORESTING WASTE LANDS

To fulfill the purposes intended by the Federal Government in its acquisition of denuded and waste areas **unfit for profitable private development** it is recommended that Congress appropriate adequate funds to plant idle lands in national forests on a scale and at a rate commensurable with the problem.

EXHIBITS AT CONFERENCE

The Georgia Commercial Forestry Conference extends its sincere thanks to the Georgia State Board of Forestry and to the Georgia Forest Service for the splendid exhibit prepared by its Bureau of Education for the Conference. This exhibit has been one of the features of our conference and has been of undoubted interest and value. We especially appreciate the presence of State Forester B. M. Lufburrow and Director of Education C. A. Whittle, whose activities have proved a great assistance in making this conference a success.

THANKS TO THE UNITED STATES DEPARTMENT OF AGRICULTURE

Appreciation and thanks were expressed to the United States Department of Agriculture for the attendance and participation in the Conference of Dr. L. C. Gray, Dr. W. W. Skinner, Dr. Austin Cary, Dr. E. P. Veitch, Mr. Lenthall Wyman and Mr. R. D. Garver. The United States Department of Agriculture was asked to print and distribute in Georgia 10,000 copies of Dr. Gray's address.

EXPRESSIONS OF APPRECIATION

Resolutions of appreciation were voted the Savannah Chamber of Commerce, the Savannah newspapers, the DeSoto Hotel and the Georgia Forest Service for contributions in making the conference successful. The Georgia Board of Forestry was thanked for a contribution to help Dr. Austin Cary in his important research work in connection with naval stores production.

GEORGIA FORESTRY ASSOCIATION RESOLUTIONS

At its final business meeting the Georgia Forestry Association passed the following resolutions:

REFORESTATION ACT

To encourage reforestation on many thousands of acres of cut-over land, the idea of a Forestry Contract Act was approved, provided such bill can be made satisfactory to the land owner, timber operator and naval stores producer.

FORESTRY EXPERIMENT STATION

In order to secure an experiment station to assist the naval stores industry in solving problems of production, endorsement was given for the Federal Government to purchase a tract of land not exceeding 10,000 acres for this purpose.

THANKS TO PRESIDENT WOOLFORD

The thanks of the Association was given to President T. G. Woolford for his great service rendered to the Georgia Forestry Association and progress made under his splendid leadership during the past twelve months.

APPRECIATION OF UNITED STATES CHAMBER OF COMMERCE

Thanks were given to the United States Chamber of Commerce for the work of its Natural Resources Production Department, for attendance at the Georgia Commercial Forestry Conference by Colonel W. M. Wiley and Major William DuBose Brookings, and for the Chamber's cooperation in making this Conference a great success. Especial appreciation was expressed for the services so efficiently rendered by Mr. A. A. Doppel, Forester of the National Chamber, who has been untiring in his efforts to make every detail of the Conference a complete success.

APPRECIATION OF PARK

Thanks were expressed to Mr. Fred Vogel, Jr., of Milwaukee, Wisconsin, for the gift of Vogel State Forest-Park at Neel Gap in Union County which, it is hoped, is the beginning of a State system of Forest-Parks in Georgia for outdoor recreation and forestry demonstrations.

EDUCATIONAL PROJECT

Thanks were expressed to the American Forestry Association for cooperation with all Georgia Agencies in visual instruction in the public schools and for the services of Mr. W. C. McCormick, Director of the Southern Forestry Educational Project.

SAVANNAH AGENCIES

Thanks were expressed to the Savannah Chamber of Commerce, the De Soto Hotel, the Convention and Tourists Bureau of Savannah, and all Savannah people who contributed to the success of this best meeting ever held by the Association.

GEORGIA FOREST SERVICE

Thanks were expressed to the State Forest Service for its efficient work in the State and its cooperation in making this Conference and Annual Meeting of the Association a success, and special thanks were given to the Bureau of Education of the State Department for the exceptional display of exhibits for this meeting.

OFFICERS OF GEORGIA FORESTRY ASSOCIATION

The Report of the Nominating Committee was unanimously adopted and the following officers were elected for the ensuing year:

Mr. T. G. Woolford, Atlanta, President
Mrs. M. E. Judd, Dalton, 1st Vice President
Mr. S. H. Morgan, Guyton, 2nd Vice President
Mr. Wm. Folks, Waycross, 3rd Vice President
Mr. Joseph A. McCord, Sr., Atlanta, Treasurer

Bonnell Stone, Blairsville, Secretary·

The Executive Committee included the above named officers and Mr. C. B. Harman, Atlanta; Mr. H. L. Kayton, Savannah; Mr. A. K. Sessons, Cogdell; Mrs. Nora L. Smith, Ashburn; Col. R. E. Benedict, Brunswick; Mr. Jas. B. Nevin, Atlanta; Miss Emily Woodward, Vienna; Mr. Gordon E. Reynolds, Albany; Mr. B. C. Milner, East Point; Judge Ogden Persons, Forsyth; and Mr. W. T. Anderson, Macon.

Bulletin, 12 DECEMBER, 1930

Georgia Forest Service

B. M. LUFBURROW, *State Forester*

Forests and Water

By

C. A. WHITTLE, *Director of Education*

GEORGIA FOREST SERVICE

Table of Contents

Forests and Water

By

C. A. WHITTLE, *Director of Education*

INTRODUCTION

Forests conserve rainfall. This is of great significance for it means that forests can be used to control rainfall for the best interests of mankind.

Unrestrained rainfall, following the force of gravity, will rush off the earth's surface, swell the streams to a destructive force and pass quickly on to the lakes, gulfs and oceans. Forests may be used to check this loss.

Plant and animal life require a vast amount of water daily, and since rainfall does not occur daily to supply their constant needs, water must be stored and controlled.

This bulletin is designed to show how the forests can conserve and control water and to call attention to a public obligation to protect the forests so as to employ them for the maximum conservation and use of rainfall.

Forests increase the water of percolation and reduce the surface run-off. This may be stated as the fundamental factor involved in forest control of rainfall. How the forest accomplishes this control will be explained somewhat in detail.

When raindrops fall on a forest, they strike the leaves, limbs, twigs and trunks of trees. The impact breaks the drops into smaller particles, thus lessening the packing influence of raindrops on the ground. The forest floor is thus kept looser and more absorptive. Since the raindrops are broken they are more readily held and absorbed by the forest floor than if not broken.

FOREST FLOOR A FACTOR

The most important rain conserving influence is that exercised by the mulch of the forest floor. The amount of water

impounded is determined by both the thickness and character of the ground cover. Where there is a thick accumulation of leaves, twigs and humus, the impounding and absorbing of water are greatest. Where the accumulation is scant or absent, the absorption of water is small and the surface run-off is large.

The ground cover of leaves, twigs, decaying and decayed matter serves not only as check-dams against surface run-off but as a sponge to store rainfall until it percolates into the ground below.

When the rain water has been absorbed by the ground, the leaves and litter also act as a mulch to check water evaporation from the soil into the air. On cultivated lands where there is no mulch of organic matter the loss of soil water by surface evaporation is heavy, reaching as much as 50 per cent or more of the rainfall.

The amount of water stored in a forest varies also with the kind of leaves forming the cover. It is greater where the fallen leaves are small as in the case of pines, than where the leaves are large as with hardwoods.

The ground cover of forests of the north are thicker than those of the south because of the longer season of warm and moist weather in the south that favors oxidation or decay. Decay would, of course, also proceed faster in a region where there is abundant rainfall than in a region of light rainfall.

The readiness with which the underlying soil absorbs water is a factor. Sandy soil will absorb water more quickly than clay, but it will not hold as much. Clay is capable of absorbing and holding more water than sand because of its smaller soil particles. The slowness of clay to take up moisture, however, makes it more likely to lose water by surface run-off than sandy soil.

The state of decay of the organic matter of the forest floor has some influence. If there is considerable humus or decayed

matter the ability of the cover to hold water is greater than where decay has not progressed far, the reason being that the decayed matter is a better sponge for taking up water than leaves or partially decayed leaves.

Unburned Forests Provide Clean Water for Streams, Lakes and Reservoirs

Beneath the forest floor another facility exists for storing water; that is, the roots. Decayed roots leave channels down which the water can easily pass; and live roots tend to draw water down their courses.

If there are no litter and humus, as in the case of burned-over forests, the particles of soil carried by the wash, seal up the root channels and the pores of the soil surface so as to make a surface over which the water can flow rapidly away instead of penetrating the earth. Heavy grazing packs the soil and also facilitates surface run-off.

In the several ways mentioned, the forest floor operates to make a reservoir for rainfall to supply the trees with needed moisture and to feed springs.

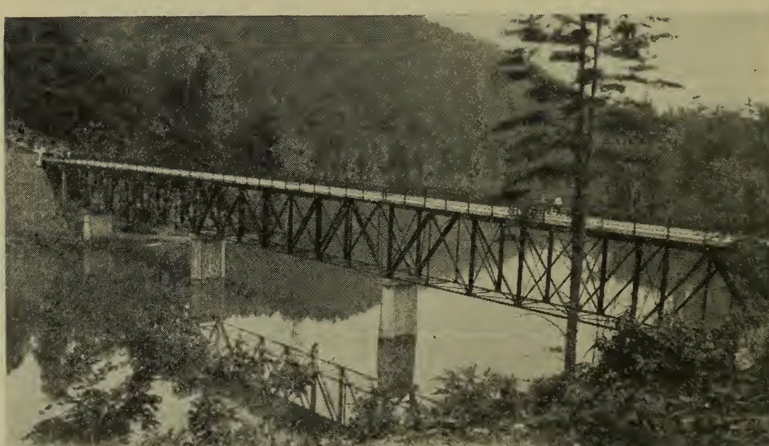
HOW MUCH WATER IS STORED

It will be of interest to know how much water a forest floor will absorb. Many research workers, mainly in Europe, have studied the problem and have found that the amount varies with conditions, but it has been concluded by authorities that it is conservative to say that on the average an inch of organic matter is capable of absorbing half an inch of rainfall. (1).

The quantity of water absorbed depends, in a measure, as has been stated, on the state of decay of the organic matter, the thickness of the ground cover and the size of the leaves.

The effect of fire on the capacity of a forest floor to hold water has been the subject of study by the Southern Forest Experiment Station. The water holding capacity of one inch of fresh, long-leaf pine litter consisting of one year's accumulation of leaf fall after fire was only 0.02 inch of water, whereas an accumulation of two inches on forest not burned over for five years was 0.17 inch.

Investigations in lake states show that Norway jack pine forests of well-decayed litter held 1,200 per cent more water than freshly fallen litter. This shows how much annual fires reduce



Water Power Lake of North Georgia, Surrounded by Forested Mountains

the water-holding capacity of the forest floor as compared to the forest floor protected for several years.

Investigations of the California Forest Experiment Station indicate that the surface run-off of forest soils from which litter has been removed is from ten to thirty times greater than from soils from which the litter has not been removed.

In a study made by Huffel in France, it was found that a forest with accumulated leaf litter did not yield a drop of surface run-off after a rainfall of from 2.4 to 2.8 inches, even on the steepest slopes.

All the rain that falls on a forest may not be held in place. A very heavy deluge can not be stored and absorbed as fast as it falls, hence there will be some surface run-off in spite of a ground cover that is ideal. Even so, the water runs clear where the forest mulch is maintained. As a rule, however, no appreciable surface run-off is to be seen where there is a good covering of the forest floor.

WATER NEEDS OF FORESTS

Forests, of course, require a great deal of water in their growth processes. The roots absorb it from the soil; it is carried as sap up through the tree structure to finally evaporate as moisture through leaves and bark into the air. Unless this circulation of water is constant and the quantity ample through the growing season, maximum tree growth can not be maintained. Therefore, the maintenance of adequate mulch on the ground of a forest is essential to the most profitable rate of tree growth.

It has been estimated that "a rapidly growing forest may during the year consume and transmit into the air a volume of water equivalent in depth to 12 inches over its entire area." (3). This, however, will vary with the species. Pines may use only 3 inches while hardwoods will take as much as 12 inches. Of course, during the dormant period trees require very little water and it is during this period that the greatest amount of water is stored to feed the springs.

SURFACE EVAPORATION

Considerable water is lost by evaporation into the air. Some rainfall is intercepted and held by leaves, limbs and trunks of trees and there evaporated into the air and some is evaporated from the forest floor.

Fires Prevent Reforestation and Erosion Follows

The rainfall intercepted by the trees and evaporated into the air before reaching the ground has been estimated at from 8 per cent to 33 1-3 per cent of the total, varying with both the character of the forest and the rainfall. Trees with the greatest amount of foliage surface, of course, intercept and evaporate a greater amount of rainfall, and the heavier the precipitation of rain the less proportion of the water remains on the tree to evaporate.

The rate of evaporation from the forest floor, as has been stated, is greatest where it is burned over and least where the leaves and litter have been left to form a thick mulch.

Climatic conditions also influence the rate of soil evaporation. During either hot, dry or windy weather, more moisture is given

off than when the weather is cold or the atmosphere is humid and still.

Ebermayer (4), a German investigator, found that the rate of soil evaporation was more than twice as great where there was no leaf cover as where there was. Ney (5) determined the evaporation of a beech forest with litter to be 6 per cent of the precipitation, and without leaf litter, 15 per cent; of a pine forest, 15 per cent with litter and 24 per cent without litter.

It will thus be seen that with as high as one-third of the rainfall evaporating from tree surfaces before reaching the ground; with as much as 15 per cent evaporation from a litter covered forest floor; with trees requiring from 3 to 12 inches of rainfall for their needs and the surface run-off that will occur, the amount remaining for percolation into the soil to feed springs may not be very great.

The rate of rainfall varies in Georgia from year to year. If the total annual precipitation is from 40 to 50 inches on clayey slopes with burned-over forest floors and on soils of deep sand where percolation is rapid, there would very likely be a drouthy condition quite unfavorable to rapid tree growth even with maximum annual rainfall. Accumulated organic matter is, therefore, necessary not only to impound water for percolation on the clay slope but to check loss of water by percolation on sandy soils by holding the water as a sponge at the surface for use of tree roots.

Water for Spring Flow

Though it has been shown that the greater part of rainfall is not available for percolation, it has also been shown that keeping fires out of the forest markedly increases the water-holding capacity of the forest floor, thereby providing a greater amount of water available for underground seepage. Forests, therefore, can be used to maintain a maximum flow of springs, with all that means for increasing available water power.

Records compiled and recently announced by the New York State College of Forestry at Syracuse, have led to the conclusion that springs in wooded areas discharge five times as much water as springs in cleared areas.

Many records have been reported in Europe showing that springs have dried up after forests were removed. The National Conservation Commission (6) in a report of the influence of forests on springs, mentioned a number of instances in this country of springs disappearing or becoming greatly re-

Protected Forests Reduce Overflows Such as This

duced in flow by the removal of forests. In that report, S. W. McCallie, state geologist of Georgia says: "In north Georgia it has been noticed that in many cases streams have perceptibly lessened in flow since the destruction of the forest."

Forests for Flood Prevention

When the water of rainfall flows unrestrained over the surface of fields and forests and converges in streams the stream beds are unequal to the demand and destructive overflows take toll of land, houses, livestock and sometimes human life.

It is not water alone that makes a destructive flood. The volume of a freshet sometimes consists more of silt, sand, gravel, and woods and field litter than water itself. DeMontsey, a

French engineer, studied the contents of a torrent after a storm and found that there was two and a half times more detritus than water in the stream, the detritus being silt, sand, gravel and organic matter from forest and field.

Flood water is swifter, has greater carrying ability and greater force of impact than normal flow. Carrying as it does, stones, gravel and sand, the abrasive power of the water is great, hence we have the gashing of stream banks and the scouring away of bottom lands by overflow water.

According to a law of physics, if the velocity of a stream is increased ten times, its transporting power is increased one million times. LeConte determined that a current having a velocity of two miles an hour will move stones the size of a hen's egg and drew the conclusion that a current with a velocity of twenty miles an hour will move a boulder weighing one hundred tons.

Thus it will be seen that by increasing the flow of a stream, with its greater rapidity and its great amount of solid content, a force of tremendous destructiveness is created.

WATER CONTROL ON ABANDONED FARM LANDS BY REFORESTATION

Georgia has a great deal of abandoned farm land now being subjected to erosion. Gullies are appearing on these lands. These gullies not only militate against the growth of protective vegetation but favor the most rapid and destructive surface run-off of rainfall. It is from these gashes in the surface of the soil that the greatest amount of silt, sand and gravel is carried down to clog streams, or spread over fertile bottom lands, or else to scour away the fertile upper soil. In a word, the fresh gullies made by erosion are the greatest contributors to destructive floods.

Many of these eroded fields are reforesting by natural processes, but it takes a long time for trees to naturally establish themselves in deep gullies so as to stop erosion. The obvious thing to do for the sake of the land as well as for water control,

is to plant the land to trees before gullies become well defined, or if the gullies have appeared to dam the gullies and plant trees in them. It is also essential to plant trees on lands where there are no seed trees.

It is, of course, essential to keep fires out of abandoned fields so that the native vegetation can maintain a foothold, check erosion and hold as much rainfall on the land as possible. Keeping fires from burning sedgegrass or other vegetation on the land is also essential to protect natural seedlings or planted young trees from destruction. Reforestation and fires can not go together.

EFFECT OF FORESTS ON WATER POWER

The amount of available water power is determined more by the volume of the constant flow of streams than by the total rainfall. The constant flow of streams in turn depends largely

Full Development of Hydro-Electric Power

on the amount of rainfall stored and fed to springs and the volume of spring flow is largely determined by forests and how well forests are managed for impounding rainfall. In other

words, the volume of water power is dependent in no small measure on keeping fires out of the woods.

The power companies build dams to impound water. These dams catch and hold a good deal of flood water, but they can not catch and hold all of it. Frequently, during periods of drouth the power companies find themselves short of water, whereas if the forests had not been burned over the reservoirs would have held more water against the time of drouths.

Another serious hindrance to the maintenance of maximum water power, is the filling up of the dam reservoirs with silt, gravel and other matter. This reduction of the water-holding capacity of reservoirs can be materially lessened by keeping fire from burning off the forest floor of the water shed. As has been shown, an unburned ground cover of a forest not only turns water down into springs but such water as flows off the surface is clean and practically free of sediment.

The Morgan Falls plant of the Georgia Power Company, on the Chattahoochee river is below large cultivated areas. After 10 years the reservoir was filled up leaving only a channel through the center for the river to flow. Thus the reservoir capacity was destroyed. On the other hand, the Mathis reservoir, above which there is only forest, after 10 years' service showed little or no sign of filling up.

CONCLUSIONS

Forests conserve and control rainfall so that it can be used to serve in many ways the best interests of mankind.

The character of the forest floor largely determines the usefulness of the forest for storing water.

With the forest floor covered with years of accumulated litter the water storing capacity is greatest but with the forest floor burned over annually the capacity for storing water is comparatively small.

A thick carpet of litter on the forest floor checks loss of soil moisture through surface evaporation.

The flow of springs and streams is maintained at a higher constant level by water stored by the forest for percolation, thus providing maximum water power.

Such water as flows from a well-covered ground surface of a forest is comparatively free of silt, sand, gravel and other materials detrimental as sediments to stream beds and reservoirs.

By providing clean water as surface run-off both the volume and destructiveness of floods are reduced. Unrestrained water carries silt, sand, gravel and stones that often constitute the greater part of the volume of a freshet, and the abrasive power of these materials is such as to do great damage to stream banks and bottom lands.

Keeping fires from destroying the litter of a forest floor is essential for the conservation of the water needed for maximum tree growth, for prevention of some of the destructiveness of floods, for maintaining a higher constant flow of streams and for the reduction of reservoir sediment.

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Key to Georgia Trees

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Key to Georgia Trees

By

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ASSISTANT DIRECTOR OF EDUCATION

Key To Georgia Trees

HOW TO USE THIS KEY

All forest trees known to exist in Georgia are given in this key. The most generally used common name, as well as the scientific name is used for each species. When possible, the identification table should be taken into the woods and the trees studied in their natural habitat.

In using the identification guide, unless the identity of the tree is practically known, the use of the "Key to the Families" is almost indispensible. When the family name is found, turn to the key of the genera and species and complete the identification.

Practical use of the key is as follows: Take the leaf of a sweet gum. Its identity is unknown to us. Beginning with the general key to all the tree families, we look at Number 1. Two statements appear —"Leaves persistent" and "Leaves deciduous". At the right hand side of each statement is a number. Since the leaves of the sweet gum are deciduous and the reference number 19 is given after the words "Leaves deciduous", we turn to 19 further on in the key, looking for this number on the left side of the page.

Here we find "Leaves linear, long and flat" and "Leaves wide, with netted veins". The sweet gum is of the broadleaf type, hence we follow the reference number 20 shown on the right. Referring to 20 one finds that one is guided to 21 because the sweet gum has less than three leaves to a node, and at 21 another reference is followed to 31 because leaves are alternate. At 31 "leaves simple" and "leaves compound" appear. Since the sweet gum leaf is simple, we go forward to number 40. Since the leaf is lobed we are referred to 42 and because the leaves are palmately lobed, we are led on to number 43. Here we find the following descriptions, "Leaves with deep, pointed fissues, notched between fissues, leaf stem slender, bark scaly, branches with corky growth". This fits the description of the leaf and we learn that the common name is "Sweetgum", the scientific name "*Liquidambar styraciflua*" and the family name "*Hamamelidaceae*".

If the family name were known at the start, then we would turn to the identification table dealing with species and trace the leaf by the same method used in "Key to the Families".

Authorities used in the compiling of these tables are as follows:

Sargent's Manual of Trees of North America
Gray's Manual of Botany
Forest Trees of Georgia
Sudworth's Check List of Trees of the United States
Forest Trees of Florida
Forest Trees of Alabama
Pennsylvania Trees

As few technical terms have been used in this key as possible. To those which are used, a glossary is given.

It might be interesting to note that leaves, stems, buds and other means by which a tree is identified sometimes do not follow any given rule. Many variations will be noted by the beginner in his study of

the trees. The main characteristics by which the tree is placed in a certain class, however, are usually found and the thorough student will not be bothered by the small differences as the variations in the shape of the leaf, bark color, etc.

Any descriptions of the leaves given in the key are given of the mature leaf. Sometimes a leaf that is dark green and lustrous at maturity will be light yellowish-green and covered with heavy hairs upon unfolding in spring.

Common names given here are the names that are most commonly used in the state.

Three families are not found in the general key, but these are found in the book as follows:

Soapberry Family *(Sapindaceae)*—Page No. 36-52.
Staff Tree Family *(Celastraceae)*—Page No. 34-51.
Quassia Family *(Simaroubaceae)*—Page No. 32-51.

EXPLANATION OF TERMS

ACRID—Bitter, sour.
ACUMINATE—Tapering to a slender point.
ALTAMAHA—A large river made by the confluence of the Oconee and Ocmulgee, that runs into the Atlantic ocean below Darien, Georgia.
APEX—The end of the leaf opposite the base.
APPALACHIAN MOUNTAINS—A geographical section of the state, extending through the extreme northern part of the state in which the mountains are located.
AROMATIC—Fragrant, or strong scented.
ASTRINGENT—Sour, contracting, as causing the mouth to pucker.
COASTAL PLAIN—A geographical section of the state, extending from the Fall line near Macon and Milledgeville southward.
CORDATE—Heart-shaped.
DECIDUOUS—Dropping leaves in the autumn.
DIOECIOUS—Having staminate and pistillate flowers on different trees.
ENTIRE OR ENTIRE-MARGINED—Not notched or scalloped, having smooth margins.
FISSUE—Openings made by the separation of parts of the leaf.
GENERA—First division under the family.
GLABROUS—Smooth.
INNER BARK—Part of bark immediately beneath the outer bark.
LANCEOLATE—Shaped like a lance.
LEAF DIGITS—Parts of the leaf.
LEAFLETS—Divisions of compound leaf; might be called the leaves of the leaf.
LINEAR—Long and narrow, like a line.
MIDRIB—The main support or large backbone of a leaf, usually extending from the base to the apex, a continuation of the leaf stem through the leaf.
MONOECIOUS—Staminate and pistillate flowers separate but on the same tree.
MUCILAGINEOUS—Sticky, gluey.
NODE—Point of the intersection of the leaf on the stem.
OBLIQUE—At an angle.

OVATE—Broad.
PALMATELY—Like the open hand.
PETIOLES—Leaf stems.
PERSISTENT—Remaining on the tree.
PIEDMONT PLATEAU—A geographical division of the state between the mountains and Coastal Plain.
PINNATE—Lobed from the midrib instead of from the base.
PUBESCENT—Hairy.
PUNGENT—With a strong odor.
RUGOSE—Wrinkled, rough.
SCALLOPED—Borders cut into lobes or semi-lobes.
SPECIES—A division under the genera.
STIPULE—An appendage at the base of the leaf.
UNDULATE—Wavy on the margins.
VISCID—Sticky.

GENERAL KEY TO THE FAMILIES

1. Leaves persistent 2
1. Leaves deciduous, falling in the autumn 19
2. Leaves not needle-shaped, not linear and not scale-like 3
2. Leaves needle-shaped, linear or scale-like 5
3. Veins of leaf parallel 4
3. Veins of leaf not parallel 6
4. Leaves fan-shaped, divided into segments with segments divided at apex. Cabbage Palmetto *(Sabal Palmetto) PALMAE*
4. Leaves long, sharp pointed at apex. Yucca in *LILIACEAE*
5. Flowers monoecious, fruit a woody cone. *PINACEAE.*
5. Flowers dioecious, fruit enclosed by the fleshy disk of the flower. *Torreya taxifolia, TAXACEAE.*
6. Leaves with sharp spines. Holly *(Ilex apaca). AQUIFOLIACEAE.*
6. Leaves without sharp spines 7
7. Leaves opposite. Tea Olive *(Osmanthus americanus) OLEACEAE*
7. Leaves alternate 8
8. Leaves serrate 9
8. Leaves entire margined 12
9. Leaves with a strong resinous odor. *MYRICACEAE.*
9. Leaves without a strong resinous odor 10
10. Leaves coarsely notched, sometimes scalloped; buds covered with narrow dark-brown or black scales. Cassina *(Ilex vomitoria) AQUIFOLIACEAE.*
10. Leaves finely notched 11
11. Leaves hairy below, pointed at apex, yellowish-green. *SYMPLOCACEAE.*
11. Leaves smooth below, rounded at apex, dark green. Gordonia *(Gordonia lasianthus). THEACEAE.*
12. Leaves and twigs aromatic when crushed; buds naked; leaves leathery, rarely smooth on bottom. Bay *(Persea). LAURACEAE.*
12. Leaves and twigs not aromatic 13

13. Leaves long and sharp pointed, sometimes several times longer than wide; terminal buds clustered. Laurel Oak *(Quercus laurifolia)*; Live Oak *(Quercus virginiana)*; Myrtle Oak *(Quercus myrtifolia)*. *FAGACEAE.*
13. Leaves not elongated, wider in the middle; terminal buds not clustered 14
14. Leaves hairy below 15
14. Leaves not hairy, smooth below 16
15. Leaves thick, heavy of texture, twigs stout and hairy. Magnolia *(Magnolia grandiflora)*. *MAGNOLIACEAE.*
15. Leaves not so thick and leathery, twigs not hairy, petioles hairy and grooved. Chittamwood *(Bumelia languinosa)*; Black Haw *(Bumelia tenax)*. *SAPOTACEAE.*
16. Petioles orange colored, stout and broad; leaves leathery, dark and lustrous on upper surface and paler on lower surface. Wild Orange *(Prunus caroliniana)*. *ROSACEAE.*
16. Petioles not orange colored 17
17. Leaf stems stout, thickened at the base; leaves usually clustered at the end of the branches; trees with watery juice. *CYRILLACEAE.*
17. Leaves usually scattered along branches; trees without watery juice 18
18. Shape of branchlets usually cylindrical; leaf stem stout, short, thickened at the base; leaves dark green and lustrous above, paler below; leaf stems slightly downy. Dahoon *(Ilex cassine)* *AQUIFOLIACEAE.*
18. Shape of branchlets not cylindrical; trees with scaly buds, usually shrub size. (With the exception of Elliottia and Oxydendrum). *ERICACEAE.*
19. Leaves long, narrow and flat. Cypress *(Taxodium)*. *PINACEAE.*
19. Leaves wide, netted veined 20
20. Leaves unfailingly three at a node. Paulownia *(Paulownia tomentosa)*. *SCROPHULARIACEAE.*
20. Leaves usually less than three at a node 21
21. Leaves opposite 22
21. Leaves alternate 31
22. Leaves compound 23
22. Leaves simple 25
23. Leaves lobed from the base with 5 or 7 digits. *HIPPOCASTANACEAE.*
23. Leaves compound lobed from the midrib instead of from the base 24
24. Leaves coarsely notched or entire with veins arching along margins; bark with watery juice. Ash *(Fraxinus)*. *OLEACEAE.*
24. Leaves sharply notched with veins extending to the teeth of the leaves; leaflets usually 3, rarely 5, hairy on under side of midrib. Box Elder *(Acer negundo)*. *ACERACEAE.*
25. Leaves palmately lobed. *ACERACEAE.*
25. Leaves without lobes 26
26. Leaves notched 27
26. Leaves with smooth margins 28

27. Branchlets slender; bark thin and close on the tree. Privet *(Forestiera). OLEACEAE.*
27. Branchlets tough and durable; bark with scale-like fissues. Black Haw *(Viburnum). CAPRIFOLIACEAE.*
28. Leaves with persistent stipules; bark bitter with watery juice; leaves turn black when dried. *RUBIACEAE.*
28. Leaves without stipules 29
29. Leaves broad, ovate, heart-shaped, 5-12 inches long; branchlets stout and cylindrically shaped; twigs without terminal buds. Catalpa *(Catalpa). BIGNONIACEAE.*
29. Leaves gradually tapering or pointed at apex, not heart-shaped, less than 5 inches in length 30
30. Leaves broad with curving, parallel veins, branchlets slender, usually flattened laterally. Flowering dogwood. *(Cornus florida)*; Blue Dogwood *(Cornus asperifolia). CORNACEAE.*
30. Leaves more slender, veins joining near leaf margins, branchlets stout; leaves with undulate margins, dark green and lustrous above, smooth below. Fringe Tree *(Chionanthus virginica) OLEACEAE.*
31. Leaves compound 32
31. Leaves simple 40
32. Leaves once or single compound 33
32. Leaves twice or double compound 37
33. Leaves with stipules 34
33. Leaves without stipules 35
34. Leaflets alternate on leaf petiole, thin, yellowish green above, pale below; midrib light yellow below. Yellowwood *(Cladrastis lutea). LEGUMINOSAE.*
34. Leaflets opposite on leaf petiole, thick and slightly hairy along veins; leaves unequally pinnate. Locust *(Robinia) LEGUMINOSAE.*
35. Branches with prickles; leaflets scalloped. Prickly Ash *(Xanthoxylum clava-Hercules) RUTACEAE.*
35. Branches without prickles; leaflets notched or smooth on margin 36
36. Juice on end of leaves milky or viscid when broken; twigs and leaves not aromatic; leaflets small. Sumach *(Rhus). ANACARDIACEAE.*
36. Juice watery; twigs and leaves aromatic, leaflets large. *JUGLANDACEAE.*
37. Branches armed with thorns or sharp spines 38
37. Branches unarmed with spines 39
38. Leaflets very small, branchlets slender, leaf with 900 to 1500 leaflets; bark roughened by thick, persistent scales. Mimosa *(Leucaena pulverulenta). LEGUMINOSAE.*
38. Leaflets much larger, branchlets stout, leaf with 7 to 12 pairs of leaflets, leaflets pale yellow green below with a few scattered hairs along midrib. Kentucky Coffee Tree *(Gymnocladus dioicus). LEGUMINOSAE.*
39. Leaves unequally compound, either once or twice compound, branchlets pithy, aromatic, leaves clustered at end of branches, petioles stout and light brown. Prickly Ash *(Aralia spinosa) ARALIACEAE.*

39. Leaves equally compound, once or twice compound on same plant; thorns stout and red; bark furrowed. Locust *(Gleditsia). LEGUMINOSAE.*
40. Leaves lobed or notched 41
40. Leaves entire or smooth on margins 61
41. Leaves lobed 42
41. Leaves notched 45
42. Leaves pinnately lobed, terminal buds clustered. *FAGACEAE.*
42. Leaves palmately lobed 43
43. Leaves with deep, pointed fissues, notched on edges between fissues; leaf stem slender; bark scaly; branches with corky, winged growth. Sweetgum *(Liquidambar styraciflua) HAMAMELIDACEAE.*
43. Leaves not notched between fissues, branches without corky growth 44
44. Leaf petioles slender and angled, bark thick, brown and furrowed, terminal bud much longer than lateral buds. Yellow poplar *(Liriodendron tulipifera). MAGNOLIACEAE.*
44. Leaf petioles stout, leaves more rounded with shallow fissues; bark gray and divided into plate-like scales; winter buds short and brown. Sycamore *(Platanus occidentalis). PLATANACEAE.*
45. Stipules or leaf appendages absent 46
45. Stipules or leaf appendages present 49
46. Leaves heavy and leathery; juice of trees watery and usually yellowish. *Symplocos. SYMPLOCACEAE.*
46. Leaves thinner, not leathery; juice of plants usually not yellowish 47
47. Leaves and twigs with a sour, bitter taste; bark thick and deeply furrowed. Sourwood *(Oxydendrum arboreum). ERICACEAE.*
47. Leaves and twigs without acid taste 48
48. Leaves finely notched, sharp pointed and long at apex, petioles and branchlets slender, pithy. Silverbell *(Halesia). STYRACACEAE.*
48. Leaves coarsely notched, rounded at apex, petioles stout, bright green on upper surface, pale on lower surface; found in Altamaha swamps and not seen wild since 1790. Gordonia *(Gordonia alatamaha). THEACEAE.*
49. Leaves coarsely notched 50
49. Leaves finely notched 51
50. Leaves light yellowish green and very lustrous, smooth and very rarely downy beneath, clustered at end of branchlets; bark smooth and pale; buds chestnut brown and elongated; fruit a solitary nut ¾ inch long in prickly bur. Beech *(Fagus grandifolia). FAGACEAE.*
50. Leaves darker green with prominent teeth, not clustered; bark furrowed, buds very short and stubby; fruit usually in twos or threes in large prickly bur, larger than beech nut. Chestnut *(Castanea). FAGACEAE.*
51. Leaves commonly with one or more lobes, crisp and rough on both sides. Mulberry *(Morus & Broussonetia). MORACEAE.*
51. Leaves not lobed 52
52. Leaves oblique at base 53

52. Leaves not oblique at base 55
53. Leaves heart shaped at base, branchlets fairly stout; inner bark tough and fibrous. Basswood *(Tilia)*. *TILIACEAE.*
53. Leaves not heart shaped at base 54
54. Leaves very broad, wavy on margins, leaf stems slender and usually hairy. Witch Hazel *(Hamamelis)* *HAMAMELIDACEAE.*
54. Leaves never broad, either slightly or conspicuously oblique at the base, simply or doubly serrate, inner bark tough, wood hard. *ULMACEAE.*
55. Leaves very broad across the base; bark furrowed and pale; leaf stems more or less vertically flattened; buds resinous and with thin scales, increasing in size toward the end of the twigs. Aspens and Cottonwoods *(Populus)*. *SALICACEAE.*
55. Leaves not as broad across the base 56
56. Leaves long and slender, from 4 to 7 times as long as wide; bark scaly with watery juice; branchlets slender and tough; trees usually found near water or swampy places. Willow *(Salix)*. *SALICACEAE.*
56. Leaves less than 4 times as long as wide 57
57. Bark of trunk smooth 58
57. Bark of trunk rough and shaggy 60
58. Leaves doubly notched, sharp pointed on end, sometimes unequal at base; bark light gray; wood very hard. Hornbeam *(Carpinus caroliniana)*. *BETULACEAE.*
58. Leaves singly notched 59
59. Leaves finely and singly notched, thin yellowish-green above, slightly hairy on lower surface, prominent yellow midrib; leaf petioles slender and hairy; bark grayish, slightly furrowed, with acrid, bitter taste. Indian Cherry *(Rhamnus caroliniana)* *RHAMNACEAE.*
59. Bark with watery juices, sometimes with bitter taste; thorns sometimes present; leaves sometimes clustered at end of twigs; fruits on almost all species edible; flowers perfect; leaves as a rule small. *ROSACEAE.*
60. Bark smooth and resinous, becoming thick and furrowed and sometimes separating into plate-like scales on older trees; leaves finely and usually doubly notched; twigs sometimes covered with pale dots; juice of inner bark watery, sometimes sweet. Birch *(Betula)*. *BETULACEAE.*
60. Leaves sharply and doubly notched, dark yellowish green, tough; leaf stems hairy; bark broken into thin, reddish-brown scales; wood hard, tough and durable. Ironwood *(Ostrya virginiana)*. *BETULACEAE.*
61. Juice in leaf stem milky and slightly acrid; bark furrowed, thick and orange-colored, armed with thorns; leaf stem long, slender and hairy. Osage Orange *(Maclura pomifera)*. *MORACEAE.*
61. Juice in leaf stem not milky 62
62. Leaves lobed, sometimes with 2 or 3 lobes; branchlets brittle, with pith; bark thick and furrowed; inner bark aromatic. Sassafras *(Sassafras)*. *LAURACEAE.*
62. Leaves not lobed 63
63. Leaves hairy on one or both surfaces 64

63. Leaves smooth on both surfaces 69
64. Leaves hairy on under side; branches hairy, pithy, wood soft and exceedingly light. Corkwood *(Leitneria). LEITNERIACEAE.*
64. Branches not pithy; wood as a rule hard and much heavier 65
65. Leaves clustered on end of branches 66
65. Leaves not clustered on ends of branches 67
66. Leaves heavily covered with hairs below; leaf stems and branches hairy; thorns sometimes found on branches. Ironwood and Chittamwood *(Bumelia tenax* and *Bumelia lanuginosa). SAPOTACEAE.*
66. Leaves only slightly hairy below; leaf stems and branches nearly smooth, without thorns. Black gum *(Nyssa). NYSSACEAE.*
67. Leaves with scales or flakes or thick hairs on lower surface, usually with a heavy coat of hairs; leaf stems hairy; bark of tree thick, close and a smooth reddish-brown. Sweetleaf *(Styrax). STYRACACEAE.*
67. Hairs usually very thin and slight or missing on leaf and leaf stem 68
68. Leaves leathery, sometimes with very slight hairs; leaf stems stout, sometimes smooth and sometimes hairy; bark thick and checked; wood very hard; inner bark bitter; roots stringy. Persimmon *(Diospyros virginiana). EBENACEAE.*
68. Leaves not so thick and heavy; tree with gray or brown bark, usually smooth; bark aromatic; roots fleshy. Cucumber tree *(M. acuminata)* and Large Leaf Cucumber Tree *(M. cordata) (M. macrophylla)* and Flowering Magnolia *(M. grandiflora).* Laurel Magnolia *(M. Virginiana). MAGNOLIACEAE.*
69. Leaves widest near apex, narrowing to base, emitting disagreeable odor when crushed 70
69. Leaves widest near middle, narrowing to base and apex, without strong disagreeable odor 71
70. Leaves heart-shaped at base; bark aromatic rather than pungent. Umbrella Tree *(M. tripetala).* Mountain Magnolia *(M. Fraseri, M. pyramidata) MAGNOLIACEAE.*
70. Leaves not heart-shaped at base, reddish brown, divided into small, shallow fissues; minute buds; bark pungent. Pawpaw *(Asimina triloba). ANNONACEAE.*
71. Leaves broad with curving, parallel veins, clustered at ends of branches; leaf stems grooved and hairy. Alternate Leaf Dogwood *(Cornus alternifolia). CORNACEAE.*
71. Leaves 2 or 3 times as long as wide, veins not parallel; leaf stems slender and flattened. *Laurel (Elliottia). ERICACEAE.*

PINE FAMILY

PINACEAE

Some Facts About Pines

Geology has proven that cypress, a member of the pine family, is the oldest living representative of arborescent or tree type vege-

tation, with the possible exception of the Ginkgo or Maidenhair tree.

The Pine family with the Yew family *(Taxaceae)* compose the conifers. The only member of the Yew family in Georgia is the Torreya *(Tumion taxifolium)*.

Pines mature their seed in cones in two or more years. The seed are produced in pairs in the cones, but they separate when the cone opens and are released. Because of the winged appendage on the seed, the wind is their chief agent of distribution.

Because of their quick appearance on abandoned fields, in open woods after logging, etc., pines are plentiful over the entire state. In spite of the diversified conditions in Georgia, some species and usually a number of species seem to fit into every condition. In Rabun county, for instance, is found the Table Mountain Pine. White Pine is found in the mountains throughout the northern portion of the state. Pitch Pine is found on some of the higher peaks and ridges in the northern part of the state. Scrub Pine extends down from the mountains to the upper Piedmont Plateau. On this plateau are Loblolly and Shortleaf, while Longleaf is found scattered in the western part of the region. Longleaf extends through the coastal plain to the coast. On the coastal plain are also found Slash, Loblolly and Pond in great numbers. Sand and Spruce Pines are scattered.

Pines are divided into two general classes, Soft Pines and Pitch Pines. In the former class, the only representative in Georgia, and in fact in the eastern part of the United States, is White Pine.

Because of their quick growth and ability to produce in thick, heavy stands, Longleaf, Slash, Loblolly and Shortleaf pines are important in the lumber industry of the state. All are sold under the name "Southern Yellow Pine".

Slash and Longleaf pines in Georgia produce a considerable portion of the world's naval stores.

All species of pines in Georgia have been used for manufacturing Kraft paper and recent discoveries indicate that they can be used for making white paper.

Key to Pine Genera

1. Fruit a round berry with hard seeds, wood aromatic; bark usually in thin shreds; needles either scale-like or linear. Red Cedar *(Juniperus virginiana)*.

1. Fruit a dry cone with numerous winged seeds........................ 2

2. Needles scale-like, closely overlapping on twigs, bark thin scaly or deeply furrowed; branches slightly flattened; cones small, about ¼ inch in diameter. White Cedar *(Chamaecyparis thyoides)*.

2. Needles linear or flattened.. 3

3. Needles in bundles of two or more. Pines *(Pinus)*.

3. Needles solitary 4

4. Needles 4 cornered, slender and pointed, arranged all around the twig; bark in thin, close, reddish brown scales. Red Spruce *(Picea rubra)*.

4. Needles flattened, arranged in opposite rows on twigs........ 5

5. Twigs rough; fruit in the form of small elongated cones, frequently at the end of twigs; bark deeply furrowed, inner bark acid; tree of the Appalachian mountains. Hemlock. *(Tsuga).*
5. Twigs smooth; fruit in the form of small balls, situated along side of twigs; bark grayish-brown having close elongated flaky bark; tree of the lower Coastal plain, native to swamps. Cypress *(Taxodium).*

Key to Pine Species

1. Needles 5 in a bundle. White Pine *(Pinus strobus).*
1. Needles fewer than 5 in a bundle 2
2. Needles 3 in a bundle 3
2. Needles 2 in a bundle 7
3. Needles 12 to 15 inches long, clustered at end of twigs, forming a rounded head; cones 6 to 10 inches long, slightly curved, thickly scaled and armed with small prickles. Longleaf Pine *(Pinus palustris)*
3. Needles less than 12 inches long, not clustered; cones less than 6 inches long 4
4. Needles 8 to 12 inches long; cones 3 to 6 inches long, shiny, thin-scaled and armed with fine prickles. Slash Pine *(Pinus caribaea).*
4. Needles 8 inches long or less, cones not shiny 5
5. Cones 3 to 5 inches long, needles slender, 6 to 8 inches long, slightly twisted and stiff. Loblolly Pine *(Pinus taeda)*
5. Cones less than 3 inches long 6
6. Needles 5 to 8 inches long, cones 2 to 2½ inches long, ovoid with slender prickles; a tree of the Coastal Plain. Pond Pine *(Pinus serotina).*
6. Needles 3 to 5 inches long, cones 1 to 3 inches long; thin, flat scales with rigid prickles; tree of the mountains. Pitch Pine *(Pinus rigida).*
7. Needles 3 to 5 inches long, sometimes found in clusters of 3, slender and flexible, cones 1½ to 2½ inches long. Shortleaf Pine *(Pinus echinata)*
7. Needles 3 inches long or less 8
8. Needles 2 to 3 inches long; cones 3 to 4 inches long, thickly scaled and heavily spiked with bristles. Table Mountain Pine *(Pinus pungens).*
8. Cones less than 3 inches long, thin scaled and with very small prickles 9
9. Needles 1½ to 3 inches long; cones 1 to 2 inches long, slightly curved; a tree of the upper Piedmont Plateau and mountains. Scrub Pine *(Pinus virginiana).*
9. Needles 2 to 3 inches long; cones 1½ to 3 inches long, shiny, thin-scaled, covered with short prickles; a tree of the lower Coastal Plain 10
10. Cone oblique at base, armed with stout prickles, tree with dark green appearance; bark rough and furrowed; found only occasionally. Sand Pine *(Pinus clausa).*

10. Cones not oblique at base; bark smooth; tree usually found near water, has appearance of white pine; prickles on cone weak. Spruce Pine *(Pinus glabra)*.

Key to Cypress

1. Leaves sharp pointed, tree small in size, not very common. Pond Cypress *(Taxodium ascendens)*.
1. Leaves blunt on end; tree grows to large stature; common cypress of south Georgia. Bald Cypress *(Taxodium distichum)*.

Key to Hemlocks

1. Needles flattened on both sides of twigs, giving twigs flattened appearance; common tree throughout mountains of northern Georgia. Hemlock *(Tsuga canadensis)*.
1. Needles projecting from all sides of twig, giving twig rounded appearance; tree found in high altitudes, very rare in Georgia. Carolina Hemlock *(Tsuga caroliniana)*.

Key to Red Cedars

1. Fruit ¼ to 1-3 inch in diameter, seed 1 and 2, rarely 3 and 4 in fruit; leaves long and sharp-pointed; tree distributed over entire state. Red Cedar *(Juniperus virginiana)*.
1. Fruit less than ¼ inch in diameter; seed always 1 or 2 in fruit; leaves shorter and more slender as a rule than virginiana; tree native to lower Coastal Plain; not common. Red Cedar *(Juniperus lucayana)*.

YEW FAMILY

TAXACEAE

One species is recognized in Georgia, known as Torreya or Stinking Cedar *(Torreya taxifolia Arn.)*, *(Tumion taxifolium, Greene)*.

The greater number of this family is found in the western states. This family, with the Pines, make up the class *Gymnospermae*.

Needles of this tree are somewhat rounded, dark green and lustrous above, paler below, arranged on both sides of the twig, giving the twig a flat appearance; bark thick, brown, faintly tinged with orange color, irregularly divided into broad, shallow fissues. Plant rare and local, found only in the extreme southern part of the state.

PALM FAMILY

PALMAE

This family was formerly known as PALMACEAE. Of the 7 genera found in the United States, only one *(Sabal)* is native to Georgia. One species is represented. This is the Cabbage Tree, Cabbage Palmetto or Palmetto *(Sabal Palmetto)*. Its most common occurrence in the state is near the coast.

This species is popular for ornamental planting. Its leaves are fanshaped, 5 to 6 feet long and 7 to 8 feet wide, with deeply divided leaf segments. This tree is leafy only at summit, at the end of only a slightly tapering trunk. This palm is our only tree palm. It cannot be mistaken for any other tree in Georgia.

LILY FAMILY

LILIACEAE

Of this family, only two species are found in the state; the Spanish Bayonet *(Yucca aloifolia)* and the Spanish Dagger *(Yucca gloriosa)*. Both of these species are found along the coast, attaining small tree size. With the exception of baskets and mats made from the tough fibers of the leaves and as ornamental trees, they have no commercial value.

Spanish Bayonet may be recognized by its leaf that is notched into small sharp tips; by its concave upper surface and its rough, dark-brown bark.

Spanish Dagger has a leaf that is smooth on its edges or has a very finely notched margin. Its upper surface is concave only toward the tip and the bark is smooth and light brown in color.

WILLOW FAMILY

SALIACEAE

Some Facts about the Willow Family

The willow family consists of the genera Willow *(Salix)* and Cottonwood *(Populus)*, the latter sometimes being called Poplar or Aspen. The well known Yellow Poplar is not included in this family, but is a true Magnolia.

The willow family is well known for its ability to grow from root and shoot cuttings. A willow or cottonwood fence post placed in the ground will frequently develop roots and branches.

Willows produce soft, light wood subject to quick decay. The twigs are sometimes used in the manufacture of baskets and furniture. Willow bark is rich in Salicin which is used in tanning and sometimes as medicine.

The Weeping Willow *(Salix babylonica L.)* is commonly found in the state as an oranmental tree, and in a few instances has escaped into the forest.

Buds of the cottonwood are often slightly resinous.

Cottonwoods are commercially important as pulpwood and in the manufacture of small woodenware. The bark contains tannic acid and the juice from the buds of some species is used as medicine.

Silverleaf or White Poplar *(Populus alba L.)*, Lombardy Poplar *(Populus nigra var. Italica, Du Roi)* and the Carolina Poplar *(Populus canadensis var. Eugenie Sch.)* are found planted over the state as ornamental trees.

Distribution of both genera of this family is brought about by the light fluffy seed that are carried by the wind and by water; also by their unusual ability to sprout from shoots and cuttings.

Key to Willow Genera

1. Buds with several scales; leaves broad and usually wide at the base, coarsely dentate with rounded lobes; trees large and fast growing with pale, furrowed bark. Cottonwoods. *(Populus)*.
1. Buds with one scale; leaves narrow and notched sharply, bark brown in broad flat connected ridges. Willows *(Salix)*.

Key to Poplar Species

1. Leaf stems rounded, leaves shaped more or less like a heart, coarsely notched on edges. Swamp Cottonwood. *(Populus heterophylla)*.
1. Leaf stem flattened laterally 2
2. Leaves 3 to 5 inches long, broad, slightly heart-shaped at base; leafstems sometimes tinged with red. Cottonwood *(Populus deltoides)*.
2. Leaves 2 to 3 inches long, not heart shaped at base; leaf stems prominent, yellow. Large Tooth Aspen *(Populus grandidentata)*.

Key to Willow Species

1. Leaves lustrous green on both surfaces, sometimes slightly hairy on under surface of leaf veins, 3 to 6 inches long and ⅛ to ¾ inch wide; bark dark brown, separated into small plates, shaggy on old trunks. Black Willow *(Salix nigra)*.
1. Leaves pale on under surface; bark furrowed but not separated into plates 2
2. Leaves smooth above, sometimes hairy below, 2 to 4 inches long, ½ to ¾ inch wide; leaf stems very hairy; bark dark, sometimes nearly black, divided into broad, flat ridges. Black Willow *(Salix longipes)*.
2. Leaves light green above, pale and smooth below, 4 to 5 inches long, ¾ inch wide; leaf stems smooth; bark dark reddish brown, deeply furrowed. Harbison Willow *(Salix Harbisonii)*.

Salix longipes var. venulosa with narrower leaves and longer leaf stems is also found within the range of *Salix longipes*.

WALNUT FAMILY

JUGLANDACEAE

Some Facts about the Walnut Family

Juglans is from Kapva, the ancient name of the walnut, which means "Jupiter's nuts".

This family is divided into two genera, the Walnuts and the Hickories. These are found scattered throughout the state.

Hickories once grew in extended forests over Europe. They were destroyed during the glacial age and none of this family is now native to the old country.

All species of this family but one are found east of the Rocky Mountains.

Fruit of both genera are usually edible. The bark and husks of the fruit are sometimes used in the manufacture of dyestuffs.

Walnuts and Hickories are highly prized for their wood.

Walnut is used where high quality wood is desired for veneer and furniture and for cabinet making.

Hickory is used in the manufacture of articles requiring strength, flexibility and lightness, as in the manufacture of handles, wagon and vehicle bodies, spokes, etc.

Gravity, water and squirrels are the main factors for distributing this family since the seed is a heavy nut.

Key to Walnut Genera

1. Pith of twigs chambered; nuts wrinkled; husks do not split; bark divided into broad ridges. Walnuts *(Juglans)*.
1. Pith of twigs continuous; nuts ridged or smooth with husk that splits open on ripening of nut; bark of tree either smooth or scaly. Hickories *(Carya)*.

Key to Walnut Species

1. Leaves often sticky and hairy; nut elongated; bark gray; habitat in mountains of Georgia. Butternut *(Juglans cinerea)*.
1. Leaves not sticky and hairy; nut round; bark dark brown; habitat over entire state with the exception of the immediate neighborhood of the coast. Black Walnut *(Juglans nigra)*.

Key to Hickory Species

1. Leaflets broad 2
1. Leaflets slender 3
2. Leaflets very broad, yellow-green and smooth beneath, 5 and rarely 7 leaflets; fruit solitary or in pairs, slightly depressed at apex; bark in long light-gray plates; buds dark brown and hairy; smooth or hairy leaf stems; a tree of mountains and upper Piedmont. Shagbark Hickory *(Carya ovata)*.
2. Leaflets not as broad as above, but decidedly pointed at apex, 7 and rarely 5 leaflets, smooth and green on lower surface, leaf stems smooth; fruit single; bark pale gray and only slightly ridged. Pignut Hickory *(Carya ovalis)*.
3. Leaves smooth on lower surface 4
3. Leaves hairy on lower surface 5
4. Leaflets slender, yellow-green beneath, 3 to 5 in number, leaf stem smooth; fruit broader than long, solitary; bark light-gray and plated, giving tree a shaggy appearance; buds reddish-brown, smooth; a tree found in the mountains. Shagbark Hickory *(Carya Carolinae-septentrionalis)*.

4. Leaflets slightly enlarged in middle, 5 to 7 in number, yellow-green below; stems smooth; fruit clustered in twos and threes; bark close, ridged and light gray; buds light brown, smooth. Pignut Hickory *(Carya glabra)*.
5. Tree having plate-like bark, shaggy in appearance 6
5. Tree having slightly ridged bark 7
6. Leaflets brown, smooth or hairy on lower surface, 7 to 13 in number; leaf stems hairy; bark light brown; nuts in 3 to 4 clusters, very compressed; buds dark, reddish-brown and hairy; coast tree. Water Hickory *(Carya aquatica)*.
6. Leaflets light-yellow and hairy on lower surface, 7 to 9 in number; leaf stems red and hairy; fruit in clusters of 3 to 4, slightly compressed; bark in thin, light brown plates; buds hairy, bright yellow; a tree of the mountains. Bitternut Hickory *(Carya cordiformis)*.
7. Leaflets slender, pale green and hairy, covered with silvery scales beneath in spring, 7, rarely 9, in number; stems covered with hairs mixed with silvery scales; buds reddish-brown covered with silvery scales; bark pale to dark gray and slightly ridged; fruit single. Pale Hickory *(Carya pallida)*.
7. Leaflets slightly broader than above, orange or brown, hairy beneath, 5 to 7 in number; leaf stems hairy; buds dark reddish brown and hairy; fruit single or in pairs, broader than long; bark in shallow irregular ridges. White Hickory *(Carya alba)*.

Hybrids Found in State

Carya ovata var. pubescens (Variant of Shagbark Hickory)
Carya glabra var. megacarpa (Variant of Pignut Hickory)
Carya glabra var. villosa (Variant of Pignut Hickory)
Carya ovalis var. obcordata (Variant of ovalis Pignut Hickory)
Carya ovalis var. obovalis
Carya ovalis var. odorata

SWEET GALE FAMILY

MYRICACEAE

Myrtle *(Myrica, L.)*. is the only genus of this family. Thirty or forty small trees or shrubs belong to it, but Wax Myrtle *(Myrica cerifera)* is the only tree species belonging to this state.

Wax is obtained from the fruit of some of the species.

The bark is astringent and is sometimes used in medicine, tanning and aniline dye. One species *(Myrica rubra)* is cultivated in some parts of Asia for its aromatic red fruit.

The leaves of the Wax Myrtle are coarsely notched above the middle of the leaf, yellowish green above, with bright orange colored glands below, with a balsamic odor when crushed. Buds more or less oblong. The bark is thick, compact, smooth and gray. The wood is soft and brittle.

This tree is found near the coast, usually on swampy land.

CORKWOOD FAMILY

LEITNERIACEAE

This family consists of only one genus with one species. It was named by Chapman for a German scientist who was killed in Florida during the Seminole War. This is Corkwood *(Leitneria floridana)*.

This species is found in the southern part of Georgia; located definitely on the borders of the Altamaha River near the coast. The leaves are thick and firm, bright green and lustrous above, pale and heavy haired below; leaves smooth on margins. Terminal bud broad and conic, covered with pale hairs; lateral buds scattered and flattened; bark thin, dark gray, faintly tinged with brown, divided by shallow fissues into narrow rounded ridges. Small tree or shrub, usually under 20 feet in height.

The wood of this species is exceedingly soft and light, pale yellow and with no trace of heartwood. It is said to be used for floats, hence the name Corkwood.

BIRCH FAMILY

BETULACEAE

Some Facts about the Birch Family

Members of this family are found over the entire state, from the River Birch that has a wide distribution and is found chiefly in the Piedmont Plateau and Coastal Plain, to the Hazlenut and Black and Yellow Birch that are found on some of our higher mountains in northern Georgia.

Woods of birches are used extensively for high grade furniture, cabinet work and has also a value as fuel.

Hazlenuts are valuable as food. Other species besides the *C. Americana* are often cultivated in this state.

Alder wood is used in the manufacture of gunpowder and charcoal. The bark and strobules are used for medicine and in tanning leather to some extent.

Iron Wood is used for making tool handles, mallets, fence posts and for other purposes where hardness is required.

Key to Birch Genera

1. Shrub size only, not over 8 feet in height, producing large edible nuts: bark smooth, dark brown, thin; buds slightly hairy; fruit has overlapping bracts; twigs covered with stiff red hair. Hazlenut *(Corylus americana)*
1. Plant attaining small tree size; nut not edible, with smaller bracts 2
2. Bark separated into scales or plates 3
2. Bark smooth 4
3. Smooth resinous bark, often separated into thin papery plates; sap watery and sometimes slightly sweet; leaves singly or doubly notched. Birches *(Betula)*.

3. Bark in loose brown plate-like scales, usually small; leaves doubly notched, thin but tough; leaf stems having light yellow midrib. Ironwood *(Ostrya virginiana).*

4. Trees with smooth, close bark, blue gray-brown in color; leaves long, pointed on end, doubly notched with stout teeth, yellow midrib; leaf stem hairy. Hornbeam *(Carpinus caroliniana).*

4. Smooth grayish-brown bark, sometimes covered with white splotches; leaves thick, stiff and slightly undulate, very finely notched on margins, hairy beneath; woody cone-like fruit usually seen on bush at all times of year. Alder *(Alnus rugosa).*

Key to Birch Species

1. Bark close, does not separate into thin, paper-like layers; dark reddish-brown; leaves long, pointed at apex; twigs with distinct wintergreen flavor. Black Birch *(Betula lenta).*

1. Bark separating into thin paper-like layers; inner bark without wintergreen flavor 2

2. Outer bark yellowish; leaves usually rounded at base; twigs dull silvery gray. Yellow Birch *(Betula lutea).*

2. Outer bark reddish-brown; inner bark tinged with red; leaves usually wedge-shaped at base; twigs reddish-brown. River Birch *(Betula nigra).*

ELM FAMILY

ULMACEAE

Some Facts about the Elm Family

Elms produce hard, tough, very durable wood that is used for flooring, ship building, saddletrees, hubs, and for other purposes for which wood of its quality is desired.

The inner bark of some species is tough which is sometimes woven into ropes and coarse cloth. Nourishing, mucilaginous food is prepared from this bark in some parts of China.

The distribution of Elm seed is brought about by the wind.

Key to Elm Genera

1. Bark separating into large, light brown or gray plate-like scales, under which reddish-brown close bark may be seen; small tree; buds minute. Water Elm *(Planera aquatica).*

1. Bark not plated 2

2. Bark deeply furrowed, sometimes bark on old trees loose; trees attain large size; pith of twigs not chambered. Elm *(Ulmus).*

2. Bark smooth or rough with knobs; leaves acuminate or sharp-pointed. Hackberry *(Celtis).*

Key to Hackberry Species

1. Small tree or shrub; bark dark or light reddish-brown; branches hairy—Hackberry (*Celtis pumilla var. georgiana).*
1. Larger tree, bark not reddish brown, branches not hairy........ 2
2. Leaves obliquely rounded at base, sharply notched above middle, slightly roughened; bark thick, smooth, dark-brown with rough knobs; buds ¼ inch long—Hackberry *(Celtis occidentalis).*
2. Leaves not as broad or as pointed as above, smooth on both sides; bark pale gray; buds less than ¼ inch long—Sugarberry *(Celtis laevigata).*
   Celtis occidentalis var. canina, a variety of *occidentalis*, with notched leaves, is found in the northwestern corner of the state.

Key to Elm Species

1. Corky growth found on the twigs and smaller branches—Winged Elm *(Ulmus alata).*
1. Corky growth seldom found on stems of plant........................ 2
2. Leaves very rough above; twigs grayish green; inner bark mucilaginous—Slippery Elm *(Ulmus fulva).*
2. Leaves smooth, usually shiny above, inner bark not mucilaginous 3
3. Bark thick, ashy gray, divided into shallow fissues; leaves 4 to 6 inches long, 1 to 3 inches wide—American Elm (*Ulmus americana).*
3. Bark light brown, tinged with red, divided into broad flat ridges, leaves 2 to 4 inches long, 1 to 1¾ inches wide, small wings sometimes appearing during third year—Red Elm *(Ulmus serotina).*

MULBERRY FAMILY

MORACEAE

The Red and Paper Mulberries and Osage Orange belong to this family.

The Red Mulberry is cultivated in the Orient as a food for silkworms. Its wood is not strong but coarse grained and used for cooperage stock. The fruit is a sweet, edible berry, turning black when ripe.

The White or Paper Mulberry can hardly be distinguished from its cousin the Red Mulberry. Possibly it is more often lobed and has a slightly more roughened surface. The White Mulberry bears no flowers or fruit and spreads only by shoots. It was introduced from eastern Asia, and is now to be found in a wild state on the outskirts of towns.

The Osage Orange wood is used for fencing, wheel stock, etc. It gets its name from the Osage Indians and once was much desired among them as bow wood. The root bark of this species contains moric and moritannic acid and is used as a yellow dye. The leaves of this species are not notched as the other two species of this family. It is also smaller and not lobed.

Distribution of the Red Mulberry is through birds, animals and water and the Osage Orange through water and gravity.
Red Mulberrry *(Morus rubra).*
Paper Mulberry *(Broussonetia papyrifera).*
Osage Orange *(Maclura pomifera).*

BEECH FAMILY
FAGACEAE

Some Facts about Beech Family

In economic importance, the Beech family is second only to the pines. Members of this family are able to reproduce by sprouts as well as by seeds.

Chestnuts of this family are highly prized for food. The chestnut wood is durable in contact with the soil and makes good fence post material. The wood is also rich in tannic acid and is locally known as "acid wood." In many portions of the country, chestnut blight has almost entirely wiped out these valuable trees. Experiments are being carried on with a new species, *Castanea crenata,* S. & Zucc., the Japanese Chestnut, which is believed to be blight resistant.

Oaks are the most important group in the beech family. More species of oaks are found in Georgia than any other genera. Because of their great strength and ability to stand strain oaks are prized for building material.

Bark from some oaks produces tannic acid which is used in the tanning of leather. Bark from some European species produces cork.

Oaks are divided into two general groups, the White Oaks and Black Oaks, according to their fruiting habit. The White Oak group is called the annual oaks or *Lepidobalanus,* while the black oak group is known as the biennial oaks or *Erythrobalanus.* The white oak group has the following characteristic: "Acorns mature in one season; leaves have rounded lobes, not bristle pointed; shell of nuts usually smooth inside, kernel sweet, bark pale and often scaly." The black oak group is described as follows: "Acorns mature in two seasons, leaves bristle pointed, cups usually hairy inside, bark dark, usually furrowed."

Black Jack Oak, though numerous, is perhaps the least important of the oaks in Georgia, since the wood is not hard, nor durable and does not have qualities of a desirable tree. It is usually removed from the forest.

For the first two years, the oak seedling concentrates its growth in the roots. Transplanting is, therefore, not advisable. Almost all oaks are valuable as fuel. Some are highly valued for furniture and cabinets.

The natural distribution of the family occurs through gravity, water and squirrels.

Key to the Beech Genera

1. Staminate flowers in rounded heads; nuts triangular; buds long and slender, sharp pointed and four or five times as long as wide—Beech *(Fagus).*

1. Staminate flowers elongated, slender; nuts not triangular; buds usually short, stout and stubby........ 2
2. Staminate flowers erect or ascending; nuts enclosed in a prickly bur; terminal buds absent—Chestnut or Chinquapin *(Castanea)*.
2. Staminate flowers drooping; nuts partially surrounding by an open, scaly cup; buds clustered on end of twig—Oak *(Quercus)*.

Key to Chestnut Species

1. Plant attains only shrub size, usually about 3 feet high; found near coast; leaves with pale hairs on lower surface. Chinquapin *(Castanea alnifolia)*.
1. Plant attains size of tree; found in mountains and to middle of coastal plain 2
2. Large trees, leaves oblong, lanceolate, smooth and green on both sides; nuts usually 2 to 3 in a bur; buds ¼ inch long, covered with smooth, chestnut brown scales. Chestnut *(Castanea dentata)*.
2. Small trees or tall shrubs; leaves oblong, whitish, downy beneath; nuts rounded, usually one in a bur; buds ⅛ inch long, covered with red scales. Chinquapin *(Castanea pumilla)*.

Castenea alnifolia var. floridana is found in the southern part of the state.

Key to Oak Species

1. Leaf blades or their lobes without bristle tips; acorns maturing at the end of the first season, immature acorns never found in winter; scales on acorn cup slightly knotted........ 2
1. Leaf blades or their lobes with bristle tips; acorns maturing at the end of two years; immature acorns may be found on trees in winter; scales on acorn cup more or less flaked instead of knotted 12
2. Leaf blades deeply lobed 3
2. Leaf blades slightly lobed or with unbroken margin 6
3. Leaves pale and smooth on lower surface 4
3. Leaves hairy on lower surface 5
4. Sinuses between lobes of leaf extend nearly to midrib, leaf usually divided into 7 or 9 lobes; leaf stems stout and smooth; bark light gray, broken into long, narrow strips. White Oak *(Querous alba)*.
4. Usually 5, rarely 3 lobed, broad at apex, upper pair of lobes larger than lower pairs; leaf smooth beneath; buds ⅛ to ¼ inch long; bark pale and scaly, ridged on old tree. White Oak *(Quercus austrina)*.
5. Leaves rusty gray or light yellow, hairy below, 3 to 5 lobed, forming the shape of a rough cross in a great number of leaves; leaf stems stout and hairy; bark dark, divided into broad ridges. Post Oak *(Quercus stellata)*.
5. Leaves with thick coat of silvery white hairs below, 5 to 9 lobed. Overcup Oak *(Quercus lyrata)*.

6. Leaves entire margined, hairy below, usually rounded at apex; leaf stems stout; bark dark brown, slightly furrowed. Live Oak *(Quercus virginiana).*
6. Leaf blades slightly lobed. 7
7. Leaf blades broadest at or below middle, oblong to lanceolate, decidedly pointed at apex; buds narrow and sharp pointed 8
7. Leaf blades broadest above middle, oblong to oblong ovate, pointed to rounded at apex; buds broadly ovoid to oval........ 9
8. Leaf blades with pointed apex, twigs slender and slightly hairy. Yellow Oak *(Quercus Muhlenbergii).*
8. Leaf blades with acute apex, twigs stouter and smooth. Chestnut Oak *(Quercus montana).*
9. Leaf scalloped, short, broad point at apex, leaves slightly roughened on upper surface. Swamp White Oak *(Quercus prinus).*
9. Leaf not scalloped 10
10. Leaf enlarged toward apex, wavy on margin, sometimes slightly lobed, slender and smooth below, leaf 2 to 3 inches long and ¾ to 1 inch wide; bark in large, irregular plate-like scales. Chapman White Oak *(Quercus Chapmanii).*
10. Leaf sometimes slightly 3 lobed at apex, lower surface sometimes slightly downy 11
11. Leaf slightly 3 lobed toward rounded apex, sometimes apex acute, leaves sometimes slightly laterally lobed, 6 to 7 inches long, 3 to 3½ inches wide, lower surface either slightly downy or smooth; bark thin, light gray and in thin scales. Durand White Oak *(Quercus Durandii).* L
11. Leaf only sometimes slightly 3 lobed toward apex, leathery, yellow-green and lustrous above, orange or brown hairs below, very thick, 6 to 7 inches long and sometimes broader at apex than the leaf is long; bark dark brown and deeply divided into almost square plates. Blackjack Oak *(Quercus marilandica).*
12. Leaf blades shallowly lobed 13
12. Leaf blades deeply lobed 18
13. Leaf blades not dilated at apex 14
13. Leaf blades dilated at apex 15
14. Leaves several times as long as wide, tapering into long apex, pale and sometimes hairy below; bark as a rule smooth, light brown in color, dark and rough on old trees. Willow Oak. *(Quercus phellos).*
14. Leaves elliptic, shorter than willow oak, sometimes rounded at apex, petioles stout and yellow; bark dark brown with a tinge of red, smooth, on old trunks divided into flat ridges. Laurel Oak *(Quercus laurifolia).*
15. Bark divided into almost square plates covered with small dark brown scales; leaves elongated, 4 times as long as wide, very rarely 3 lobed at apex, blue-green, lustrous above, pale and hairy below; leaf stems short and stout. Blue Jack Oak *(Quercus cinerea).*
15. Bark as a rule smooth; leaves less than 4 times as long as wide 16

16. Leaves persistent throughout winter, broad only about 2 times as long as wide, rounded and swelled at apex; bark thin and smooth except near ground. Myrtle Oak *(Quercus myrtifolia).*
16. Leaves deciduous 17
17. Leaves elongated, about 3 times as long as wide, hairy beneath, more or less clustered on end of twig; bark smooth on branches, on old trunk broadly ridged; buds ⅛ inch long, leaf stems stout and hairy. Shingle Oak *(Quercus imbricaria)*
17. Leaves less than twice as long as wide; sometimes lobed; petioles stout, flattened and smooth; bark thick, close, light brown, rough on old trunks; leaves gradually falling throughout winter. Water Oak *(Quercus nigra).*
18. Leaves hairy below 19
18. Leaves smooth or shiny below 20
19. Leaves wide with shallow fissues between the lobes, covered with brown or rusty hairs beneath, usually 7 sometimes 9 lobed; leaf stems stout and yellow, inner bark yellow. Black Oak *(Quercus velutina).*
19. Characteristic leaf with 3 lobes, divided near apex, sometimes with extra pair of lobes, gray-hairy below; inner bark not yellow. Spanish Oak *(Quercus rubra).*
20. Leaves 5 to 9 lobed, buds ovoid, narrowed to acute apex 21
20. Leaves 3 to 5 lobed, buds elongated and acute 23
21. Leaf sinuses shallow; leaf stem stout; nut 1 to 1¼ inch long; bark thick, smooth, dark brown—Red Oak *(Quercus borealis maxima).*
21. Leaf sinuses deep, leaf stems slender 22
22. Leaf 7 to 9 lobed, smooth above and below, sinuses narrow; leaf stems narrow, smooth, bark ridged and broken into small plates; buds ¼ inch long, close gray smooth scales; nut oblong, rounded at apex—Shumard Red Oak *(Quercus Shumardii).*
22. Leaf usually 7, rarely 9 lobed, sinuses wide and deep, leaf lobes flared and divided on end, texture thin, leaf smooth on both sides; bark smooth and light brown, rough on old trunks; buds smaller than ¼ inch long; nut not oblong, tapered at apex—Scarlet Oak *(Quercus coccinea).*
23. Leaf stems stout, leaves 3 to 5 lobed, usually with long, keen apex lobe; nut full and rounded on end; tree of lower part of state—Turkey Oak *(Quercus Catesbaei).*
23. Leaf stems slender, leaves 5 lobed with middle pair of lobes usually much larger than lower pair; nut small, not rounded on apex; tree found only in a few counties in middle of state —Georgia Oak *(Quercus georgiana).*

Hybrid of Beech

Fagus grandifolia var. caroliniana (Commonly mistaken for *Fagus grandifolia).*

Hybrid Oaks found in Georgia

Quercus coccinea var. tuberculata (Variant of Scarlet Oak.)
Quercus Smallii (Variant of Georgia and Blackjack Oaks).
Quercus Ashii (Variant of Turkey and Spanish Oaks).
Quercus Walteriana (Variant of Turkey and Water Oaks).
Quercus rubra var. triloba (Variant of Spanish Oak).
Quercus rubra var. pagodaefolia (Variant of Spanish Oak).
Quercus rubra var. leucophylla (Variant of Spanish Oak).
Quercus Bushii (Variant of Black Jack and Black Oaks).
Quercus microcarpa (Variant of Water Oak).
Quercus dubia (Variant of Blue Jack and Laurel Oaks).
Quercus sublaurifolia (Also Variant of Bluejack and Laurel Oaks).
Quercus subintegra (Variant of Bluejack and Spanish Oaks).
Quercus carolinensis (Variant of Bluejack and Blackjack Oaks).
Quercus caduca (Variant of Bluejack and Water Oaks).
Quercus virginiana var. geminata (Variant of Live Oak).
Quercus stellata var. Margaretta (Variant of Post Oak).
Quercus succulenta.

MAGNOLIA FAMILY

MAGNOLIACEAE

The Magnolia Family is perhaps best known for its ornamental trees, but this family is also important for its lumber.

Two genera are represented in Georgia by the Yellow Poplar and Magnolias. The beginner often finds some difficulty in identifying the species of the latter genus.

Key to Magnolia Genera

1. Leaves not lobed; fruit a cone filled with fleshy seeds; buds broad to conical, sharp pointed and sometimes hairy—Magnolia *(Magnolia).*
1. Leaves 4 to 6 lobed; fruit a spindle shaped cone with dry, hard seeds; buds flattened, oblong, blunt pointed, smooth inside and outside—Yellow Poplar *(Liriodendron tulipifera).*

Key to Magnolia Species

1. Leaves distinctly heart-shaped and narrowed at base 2
1. Leaves as a rule not heart-shaped at base 4
2. Leaf silvery below; leaf stems stout and hairy; buds covered with white hairs; leaves 20 to 30 inches long, and 9 to 10 inches wide; bark smooth light gray, a tree of the mountains and Piedmont Plateau—Largeleaf Cucumber Tree *(Magnolia macrophylla).*
2. Leaf silvery below; leaf stems slender and smooth; buds smooth; leaves less than 20 inches long and less than 9 inches wide 3

3. Leaves bright green, smooth, sometimes red on veins of leaf, 10 to 12 inches long, 6 to 7 inches wide; buds purple; bark dark brown with small projections except on old trunks—Mountain Magnolia *(Magnolia Fraseri).*
3. Leaves thin, light yellow green on upper surface, pale below, 5½ to 8½ inches long, 3½ to 4½ inches wide, yellow midrib; stem slender, smooth; branchlets bright red to ashy-gray; tree of the Coastal Plain. Cucumber Tree *(Magnolia pyramidata).*
4. Leaves smooth on lower surface 5
4. Leaves hairy on lower surface 6
5. Leaves thick and stiff above, smooth, 18 to 20 inches long, 8 to 10 inches wide; stems stout and smooth; buds purple and smooth; bark light gray and smooth with small bristly growth; tree found in the mountains—Umbrella Tree *(Magnolia tripetela).*
5. Leaves abruptly short pointed at apex, yellow green above, rarely hairy on under surface, 6 to 10 inches long, 4 to 6 inches wide; buds covered with long white hairs; bark furrowed, dark brown with thin scales; a tree found in the mountains—Cucumber Tree *(Magnolia acuminata).*
6. Leaves leathery, bright green above, densely covered with rusty hairs below, 5 to 8 inches long, 2 to 3 inches wide; leaf stems stout, covered with rusty hairs; buds pale or rusty hairy; bark thick, gray or light brown; tree of the lower Piedmont and Coastal Plain—Magnolia *(Magnolia grandiflora).*
6. Leaves not as leathery, covered with pale or white hairs below, leaf stems slender and smooth 7
7. Leaves with matted pale hairs below, 4 to 5 inches long, 2½ to 3½ inches wide; buds with pale hairs; bark gray or light brown; usually found in the Savannah river valley—Cucumber Tree *(Magnolia cordata).*
7. Leaves persistant throughout winter, bright green above, white and hairy on lower surface, 4 to 6 inches long, 1½ to 3 inches wide; buds silky-hairy, bright green, smooth; tree small and slender, found in middle of state and southward—Laurel Magnolia or Bay *(Magnolia virginiana).*

CUSTARD APPLE FAMILY

ANONACEAE

Only one of the genera with one species of this family is found in this state. This is the common Papaw *(Asimina triloba).* The range of this species is from the middle of the state northward.

The fruit of the Papaw species is tasty and where the trees are naturally abundant, large amounts of it are sold.

The wood of this species is of no commercial value.

The leaves are sometimes a foot long and always widen toward the apex, narrowing to a long narrow strip at the base. The bark is dark brown, marked by grayish blotches. The buds are pointed, flattened and covered with rusty hairs.

LAUREL FAMILY

LAURACEAE

Three species are represented under two genera in this state, these are *genus Persea* with the species *Borbonia* and *palustris* and the *genus Sassfrass* with the species *officinale.*

Sassfrass is the most important of the two genera. Its wood is used for posts, interior finishing and furniture, and the roots are sometimes boiled for tea.

The Bay tree belongs to this family. It was formerly used in ship building and is now used as veneer and interior finishing. It is also used as an ornamental shrub.

This family is a large one, having some 1000 species in the world.

Key to Laurel Genera and Species

1. Twigs and leaves aromatic and mucilagenous; branchlets usually light green and lustrous, leaves one, two or three lobed with deep sinuses, hairy below; buds yellowish in color; bark red brown, deeply furrowed; found throughout the state—Sassfrass *(Sassfrass officinale).*

1. Twigs and leaves not aromatic; leaves not lobed; tree found in the swamps in the southern part of the state.......... 2

2. Leaves thick and leathery, bright green, lustrous above, smooth pale below, midrib orange colored, leaf 3 to 4 inches long, ¾ to 1½ inches wide; leaf stems stout, rigid, red brown, flattened, grooved above; buds thick and hairy; bark deep red, deeply furrowed; found in the vicinity of the coast—Red Bay *(Persea Borbonia).*

2. Leaves pale green and lustrous above, pale, rusty hairy below, 4 to 6 inches long, ¾ to 1½ inches wide; stems stout, rusty hairs; bark dull brown with shallow fissues; found in the western portion of state. Swamp Bay *(Persea palustris).*

WITCH HAZEL FAMILY

HAMAMELIDACEAE

Two representatives of this family occur in the state. These are the Witch Hazel with two species *(Hamamelis macrophylla)* and *(Hamamelis virginiana)* and Sweetgum *(Liquidamber styraciflua).*

Witch Hazel is a shrub. Extract from its bark is sometimes used for medicine.

Sweetgum ranks among the most valuable of our Georgia trees. It is used in the making of fine furniture, boxes, crates and for interior finish. A market for its gum has developed at a high price, being used in the manufacture of cosmetics. This tree was formally thought to be a nuisance with little or no value.

Key to Witch Hazel Genera and Species

1. Leaves star shaped, finely notched with 5 to 7 pointed lobes, thin green smooth and lustrous; leaf stems slender and smooth; buds orange brown and resinous; stems and branchlets covered with corky growth; bark grayish and deeply furrowed—Sweetgum *(Liquidamber styraciflua).*
1. Leaves not star shaped, not notched finely, not lobed, branchlets not covered with corky growth 2
2. Leaves stiff, dull dark green, sometimes hairy above, light colored and lustrous below, widely lobed above middle, 4 to 6 inches long, 2 to 2½ inches wide; stems smooth and slender; buds light orange brown, covered with fine hairs; bark light brown, smooth; found in northern and central Georgia—Witch Hazel *(Hamamelis virginiana).*
2. Leaves roughened, dark green above, paler below, wavy on margins, especially above middle, 3 to 5 inches long, 2 to 3 inches wide; leaf stems slender and hairy; buds rusty and hairy; bark grayish brown; found in southern portion of state—Witch Hazel *(Hamamelis macrophylla).*

PLANE TREE FAMILY

PLATANACEAE

The Plane Tree Family has only one genus with some seven species. Only one of these species is native to Georgia. This is the Sycamore *(Platanus occidentalis).* This tree will grow from cuttings and from seed. It is used as an ornamental tree. In its native habitat, it is found in wet places as along the banks of streams.

The leaves of this tree carry a dust disagreeable when breathed, usually causing a fit of coughing.

The tree may be recognized by its broad, slightly lobed leaf with stout yellow veins; scaly outer and almost white inner bark.

ROSE FAMILY

ROSASEAE

Some facts about the Rose Family

Some of our important fruit trees belong to this family and much of the wild fruit such as Cherries, Plums and some of the Haws.

Some species are important for the timber they produce. Cherries, for instance, produce a wood that is highly valued for furniture making.

This is one of the largest tree families and has world wide distribution.

Except for its use as ornamentals, the *Crataegus* or Haw, is so unimportant a species in the state, that only a list of trees of the genera *Crataegus* is prepared. These are given as follows:

BUCKTHORN — *Crataegus punctata, Crataegus amnicola, Crataegus algens, Crataegus collina, Crataegus Mohrii, Crataegus ragalis.*

RED HAW—*Crataegus arborescens, Crataegus Boyntonii, Crateagus Chapmanii, Crataegus ingins, Crataegus Sargentii, Crataegus tomentosa, Crataegus Virides, Crataegus vulsa.*

COCKSPUR THORN — *Crataegus crus-galli.*

MAY APPLE — *Crataegus aestivalis, Crataegus rufula.*

SWEET RED HAW — *Crataegus aprica, Crataegus dispar, Crataegus flava, Crataegus Ravenelli, Crataegus tristis.*

PARSLEY HAW — *Crataegus apiifolia.*

TREE HAW — *Crataegus drymophylla.*

PLUM HAW — *Crataegus georgiana.*

SMALL RED HAW — *Crataegus spathulata.*

Three species of Crab Apple occur in the state, these are *Malus angustifolia, Malus bracteata and Malus coronaria var. elongata.* The distinguishing characteristics of these are given as follows:

Malus angustifolia — Leaves leathery, 1 to 2 inches long, ½ to ¾ inch wide; stems smooth, often rose colored; bark dark reddish brown broken into small plate like scales; buds 1/16 inch long, chestnut colored hair.

Malus bracteata — Leaves light yellow-green above, thin, slightly hairy below, 3 to 3½ inches long, 2 to 2½ inches wide; bark dark brown with thin close scales.

Malus coronaria var. elongata — Leaves dark yellow-green above, pointed at apex; bark with long, narrow, reddish-brown scales; leaves 3½ to 4 inches long, 2 to 2½ inches wide, with slightly hairy, orange colored stems, usually found as small trees forming dense thickets.

Key to Rose Genera

1. Thorns usually present on twigs at nodes of the leaves; winter buds small. Red Haw *(Crataegus).*
1. Thorns absent on twigs, winter buds larger 2
2. Inner bark of twig with bitter taste and characteristic odor; fruit a drupe (with one seed); bark usually covered with horizontal lenticles. Plums and Cherries *(Prunus).*
2. Twigs not bitter; fruit a pome (with several seeds); bark without the horizontal lenticles 3
3. Buds narrow, conical and greenish-yellow; bark smooth. Service Berry *(Amelanchier).*
3. Buds not narrow, conical or greenish-yellow; leaves more or less clustered on end of twigs; bark slightly scaly. Crabapple *(Malus).*

Key to Serviceberry Species

1. Leaves yellowish green on upper surface, paler below; leaf stems smooth; buds green tinged with brown; bark dark ashy gray divided into shallow fissues; found over state, especially in the central and southern parts *(Amelanchier canadensis).*
1. Leaves dark green above, paler below, stems smooth; buds green tinged with red; bark dark reddish brown with shallow fissues, found in mountainous section of state *(Amelanchier laevis).*

Key to Plum and Cherry Species

1. Leaves thick and leathery, dark green above, paler below 2
1. Leaves thin not heavy 4
2. Leaf stem stout and thick, orange colored; bark gray rough, marked by irregular dark blotches; leaves 2 to 4½ inches long, ¾ to 1½ inches wide; buds chestnut brown, ⅛ inch long—found only in neighborhood of coast. Laurel Cherry. *(Prunus caroliniana).*
2. Leaf stem slender not orange colored; bark darker, not marked by blotches 3
3. Leaves 2 to 6 inches long, 1 to 1½ inches wide; buds broad, bright chestnut brown, acuminate on apex; ½ to 2/3 inches long; bark dark red brown, irregularly plated; found over entire state—Wild Black Cherry *(Prunus serotina).*
3. Leaves thick, rough, dull dark green above, pale below, 3 to 4 inches long, 1½ to 1¾ inches wide; buds with chestnut brown scales, ⅛ to ¼ inch long; bark brown tinged with red, in long thin plates; found over state—Wild Plum *(Prunus americana).*
4. Leaves dark green above, paler below 5
4. Leaves light or bright green above 6
5. Leaves 2 to 2½ inches long, 1 to 1½ inches wide; buds 1/16 inch long, chestnut brown; bark dark brown with small scales; leaf stem stout; found in lower part of the state—Black Sloe *(Prunus umbellata).*
5. Leaves 2 to 4 inches long, 1 to 2 inches wide, lustrous above; buds pale chestnut brown; ½ to 1 inch long, leaf stem slender; bark strongly and disagreeable scented; dark reddish brown and often rough; a tree of the upper Piedmont and mountains—Choke Cherry *(Prunus virginiana).*
6. Leaves 2½ to 4 inches long, ¾ to 1¼ inches wide; leaf stems grooved and grooves covered with white hairs; buds chestnut brown, smooth ⅛ inch long; bark thin except on old trunks; a tree of the mountains—Wild Plum *(Prunus Munsoniana).*
6. Leaves 1 to 2 inches long, 1/3 to 2/3 inches wide; buds pointed; 1/16 inch long; bark dark reddish brown, slightly furrowed; tree found over entire state—Chickasaw Plum *(Prunus angustifolia).*

NOTE — *Prunus umbellata var. injucunda,* a hybrid of the Black Sloe is distinguished from the true *umbellata* by its hairy twigs, leaves with hairs on under surface.

LEGUME OR PEA FAMILY

LEGUMINOSAE

In this family are found some of our most valuable soil improvers, as Peanut, Soy Bean, Australian Field Pea, Alfalfa and Clover. The trees in this family have the characteristic of bearing their seeds in a pod and as a rule have nodules of nitrogen on their roots. Some members of this family produce valuable dyes.

The common Locust, belonging to this group, is valuable for fence posts, being strong and durable. Fruit of the Honey Locust is edible.

Key to Legume Genera

1. Branches with thorns 2
1. Branches without thorns 3
2. Leaves odd-pinnate, or with unequal number of leaflets; twigs often have two short spines at the nodes; bark reddish brown—Black Locust *(Robinia)*.
2. Leaves with equal number of leaflets; branches and often trunks armed with long, keen thorns, reddish on the tips; bark graying to dark brown—Honey Locust *(Gleditsia)*.
3. Leaves simple, heart shaped at base; twigs slender; buds smooth—Redbud *(Cercis canadensis)*.
3. Leaves compound 4
4. Leaves with 900 to 1500 leaflets, ¼ to 1/3 inch long, 1/6 to ¼ inch wide, leaf stem slender; bark dark brown—Mimosa *(Leucanea pulverulenta)*.
4. Leaflets never number over 20, more than 1/3 inch long and ¼ inch wide 5
5. Leaves with an even number of leaflets, usually 8 to 14 in number; twigs stout; buds hairy; leaf stems slender. Kentucky Coffee Tree *(Gymnocladus dioicus)*.
5. Leaves with an odd number of leaflets, usually 7 to 9, in number; leaf stems stout—Yellow Wood *(Cladrastis lutea)*.

Key to Honey Locust Species

1. Leaflets 1 to 1½ inches long, dark green, lustrous above, dull yellow green below; bark with shallow fissues; found from the upper Piedmont Plateau southward; fruit many seeded—Honey Locust *(Gleditsia triacanthos)*.
1. Leaflets smaller than those above, dull yellow above, dark green on lower surface; bark gray or reddish brown, with small platelike scales; fruit with one seed—Water Locust *(Gleditsia aquatica)*.

Key to Black Locust Species

1. Leaves with 7 to 19 leaflets, smooth and stout leaf stem; bark deeply furrowed, dark brown with small square persistant scales—Black Locust *(Robinia pseudoacacia)*.
1. Leaflets 13 to 21 in number; clammy stem that is rough with stiff hairs, bark dark brown, smooth—Clammy Locust *(Robinia viscosa)*.

RUE FAMILY
RUTACEAE

This family is noted for its bitter aromatic volatile oil which is used in medicines.

Two genera with one species each is represented in Georgia. These are commonly known as the Prickly Ash *(Xanthoxylum clava—Herculis)*, and Hop-tree *(Ptelea trifoliata)*. The generic name of the Hop tree is taken from the classical name of the Elm. Distinguishing characteristics of these two trees are as follows:

Prickly Ash. Leaves compound, 3 to 9 pair of leaflets and with a spiny stem. Leaflets notched usually oblique at base, long, green, lustrous above, paler and often hairy below; buds dark brown or nearly black; bark light gray, roughened by corky growths.

Hop Tree. Leaves compound with 3 and rarely 5 leaflets that are finely notched or entire, leathery, dark green and lustrous above, paler below; leaf stems stout and thickened at base; buds pale or almost white; bark dark brown and lustrous, marked by corky growths.

QUASSIA FAMILY

SIMARUBACEAE

This family of trees is native to the tropics. The single species represented in this state was imported from eastern Asia, where the genus *Ailanthus* is found. "The Tree of Heaven" *(Ailanthus glandulosa)* is also known as Haven Wood, Chinese Sumach and Paradise Tree. Perhaps the most distinguishing characteristic of the tree is the large, grayish twigs covered with fine downy hairs and with heart shaped leaf scars. When these twigs are broken or crushed, they give out a rank odor.

This species has no commercial importance. It is used occasionally as a shade tree.

SUMACH FAMILY

ANACARDIACEAE

Of this family only one genera with four species is found in Georgia. These are of no commercial importance, but sometimes are used as ornamentals on account of their brilliant foliage in the fall.

The well known Poison Oak belongs to this family.

Key to Sumach Species

1. Leaf stems winged—Dwarf Sumach *(Rhus copallina)*.
1. Leaf stems not winged 2
2. Leaflets with entire margins, terminal bud present—Poison Sumach *(Rhus vernix)*.
2. Leaflets with notched margins, terminal bud absent 3
3. Twigs densely hairy—Staghorn Sumach *(Rhus typhina)*.
3. Twigs smooth—Smooth Sumach *(Rhus glabra)*.

CYRILLA FAMILY

CYRILLACEAE

The family has two genera with one species each in Georgia. The family is confined to the warmer parts of the world and the representatives in this state are found in the southern portion around the coast and swamps of the southern rivers.

The species found are Ironwood or Leatherwood *(Cyrilla racemiflora)* and Titi *(Cliftonia monophylla)*. The latter is perhaps the better known of the two and is often seen in thickets near the swamps.

Titi is valued as fuel wood. The other member of the family has no commercial importance.

Distinguishing characteristics of the two species are given as follows: Leaves of both species are thick, leathery and usually dark green.

Ironwood—Leaves usually clustered near the ends of the branches; 2 to 3 inches long and ¼ to 1 inch wide, with a stout leaf stem; buds ⅛ inch long; bark covered with scales that are large and thin and bright reddish brown in color.

Titi—Leaves clustered, persistent, 1½ to 2 inches long, ½ to 1 inch wide; leaf stems short and stout; buds ¼ inch long; bark on young stems smooth with small scale on old trunks, furrowed, red brown.

HOLLY FAMILY

AQUIFOLIACEAE

Of the Holly family, *Ilex* is the only one of the genera found in Georgia. Of this genus, the species *opaca*, the common holly, has the widest distribution and is perhaps the most commonly known because of its desirability as an ornamental shrub and for its use as Christmas decorations. The bright red berries, which are persistent through the winter and the shiny green leaves make an attractive color combination.

Key to Holly Species

1. Leaves heavy, stiff with spiny teeth on margins, dull yellow green above, pale, often yellow on lower surface; leaf stem stout and grooved; bark light gray and smooth with small projections; fruit persistent on branches during winter, found over state, very common—Holly *(Ilex opaca)*.
1. Leaves not as heavy, without spiny teeth 2
2. Leaves dark green and lustrous above; leaf stems short and stout 3
2. Leaves light green above; leaf stems slender 4
3. Leaves pale below, few hairs on lower midrib; 1½ to 3 inches long, ½ to 1 inch wide; leaf stems slightly downy; buds minute, coated with hairs; bark dark gray roughened slightly; found in swamps near coast—Dahoon *(Ilex cassine)*.
3. Leaves pale and opaque below, 1 to 2 inches long, ¼ to 1 inch wide; stems broad grooved, smooth; buds minute, nearly black, smooth; bark light reddish-brown with thin scales; small tree often forming impenetrable thickets—Cassena Berry *(Ilex vomitoria)*.
4. Leaves thick firm, pale below, hairy on midrib, 2 to 3 inches long, 1/3 to 1 inch wide; stem slender, grooved, hairy; buds minute, light gray; bark light brown, roughened by small warty knots; found in state except in mountains—Deciduous Holly *(Ilex decidua)*.

4. Leaves thin, pale below; 2 to 5 inches long, ½ to 2½ inches wide; stems smooth; buds light brown; bark light brown, roughened slightly; found in central and northern Georgia, but not common—Largeleaf Holly *(Ilex monticola)*.

STAFF TREE FAMILY

CELASTRACEAE

An interesting note on this family is that its name is taken from the old Greek word for an evergreen tree. Very few species of this family have leaves that are persistent.

Representing this family we have the Burning Bush or Wahoo *(Evonymus atropurpureus)*. The inner bark of this species is bitter.

The characteristics of the species here given are as follows: Leaves opposite, smooth on margins, minutely notched, 2 to 5 inches long, 1 to 2 inches wide; leaf stems stout; buds purple and pointed, ⅛ inch long; bark thin ashy gray and covered with thin minute scales.

MAPLE FAMILY

ACERACEAE

The maple is a dioecious tree, that is, it has flowers of the two sexes borne on different trees.

Maples are prized for their wood, which is especially valuable for cabinet work, furniture veneer and flooring. Some species produce a sugary sap, which is boiled into syrup or made into sugar.

This family is best known perhaps as a shade tree, for which purpose both native and introduced species are used. Norway Maple *(Acer platanoides)* and Sycamore Maple *(Acer Pseudoplatanus)* are perhaps most commonly used.

Maples are divided into two classes, Hard Maples and Soft Maples. This classification is based on the hardness of the wood.

Key to Maple Species

1. Leaves finely notched with 3 sharp pointed lobes with shallow sinuses near apex 2

1. Leaves not notched, usually rounded on lobes and with deep sinuses 3

2. Leaves semi-leathery, light green above, white and hairy below; leaf stems slender, smooth, red or green; buds scarlet; bark smooth and light gray with the exception of old trunks; found over state and is very common—Red Maple *(Acer rubrum)*.

2. Leaves pale green above, paler below; leaf stems stout, grooved and smooth; buds bright yellow or rose color, hairy; bark reddish brown marked by broad pale stripes; occurrence rare in northern Georgia—Striped Maple *(Acer pennsylvanicum)*.

3. Leaves compound with 3 to 5 leaflets, leaflets smooth on both sides, hairy on under veins; buds hairy; bark pale gray or light brown with exception of old trunks; found common throughout state—Box Elder *(Acer negundo)*.
3. Leaves not compound 4
4. Leaves hairy or slightly hairy underneath 5
4. Leaves smooth on both sides 6
5. Leaves thin, 3 to 5 lobes rounded, smooth, dark green and lustrous above, pale and hairy below; leaf stems slender and smooth; buds chestnut brown, smooth; bark pale and smooth except on old trunks—Sugar Maple *(Acer floridum)*.
5. Leaves thin, 3 lobes rounded, slightly scalloped, dark yellow green above, bright yellow green and hairy below; leaf stems slender, smooth; buds dark brown, bark light gray except on old trunks; common in northern and central Georgia—Whitebark Maple *(Acer leucoderme)*.
6. Leaves often leathery, 3 to 5 lobed, dark green or opaque above, green or pale below, scalloped, leaf stems slender, smooth; buds bright yellow, hairy; bark light gray-brown, broken into deep furrows and small scales; not a common tree; found in the mountains of northern Georgia—Sugar Maple *(Acer saccharum)*.
6. Leaves thin, deeply 5 lobed, widely notched with rounded lobes, bright pale green above, white and smooth beneath; stems slender, bright red; buds pale green or yellow; bark smooth and gray tinged with red except on old trunks; common in state—Silver Maple *(Acer saccharinum)*.

Maple Hybrids

Acer saccharum var. Schnekii.
Acer rubrum var. tridens.
Acer rubrum var. tomentosum.

HORSE CHESTNUT FAMILY
HIPPOCASTANACEAE

The common name for all of this family is "Buckeye." Horse chestnut, *Aesculus hippocastanum*, introduced from the mountains of Greece, has commonly seven leaves and is used as an ornamental. Fruit of the Buckeye (called "Buckeyes") are often carried as charms.

Key to Buckeye Species

1. Leaf stems hairy 2
1. Leaf stem smooth 3
2. Leaflets 5, rarely 7, dark yellow green, duller on lower surface, few pale hairs on midrib; stems slender, slightly hairy; buds bright yellow or red; bark dark brown, shallow fissues and small scales; common tree of middle and northern Georgia—*(Aesculus octandra)*.
2. Leaflets number 5, dark green and lustrous above, lighter color and hairy below; stems grooved and usually hairy; buds reddish brown; bark thin, smooth, pale; found in southeast Georgia—*(Aesculus discolor)*.

3. Plant a shrub and found near coast, leaflets dark green above, pale yellow green on lower surface; stems slender and smooth; bark light orange brown—*(Aesculus pavia)*.
3. Plant attaining both small and large tree size; found in middle or northern Georgia 4
4. Leaflets smooth, few hairs on under side of yellow midrib, yellow green on upper side, paler on lower; buds long and bright yellow; bark dark brown, scaley, old trees rough and plated; tree rare—*(Aesculus glabra)*.
4. Leaflets yellow green above, green and smooth below, orange midrib; buds reddish brown; bark thin, dark brown with small thin scales—*(Aesculus georgiana)*.

Two variants of *Aesculus georgiana* are *var. pubescens* and *var. lanceolata*, which names are descriptive of the plants.

Aesculus austrina is also a hybrid sometimes known as *Aesculus discolor var. mollis*.

SOAPBERRY FAMILY

SAPINDACEAE

Chinaberry, sometimes called the China tree *(Sapindus marginatus)* is found in this state. The berries of this tree turn yellow when ripe, are persistent on the trees in clusters, and are desirable food for birds. Seeds from these berries were often used in making beads by Indians and, when colored, were very attractive.

Leaves are compound with dark green and have, as a rule, lustrous leaflets 7 to 13 in number. The bark is reddish brown in color. The inner bark is bitter and was once used for a tonic.

BUCKTHORN FAMILY

RHAMNACEAE

Though Buckthorn is the name of this family, the species found in this state does not contain any thorns or spines. This species is commonly called Indian Cherry, *(Rhamnus caroliniana)*. Its watery juice is bitter, the inner bark acrid. The fruit and bark of this genera furnish yellow and green dyes.

The European Buckthorn *(Rhamnus cathartica L.)* is widely used as a hedge.

Leaves of the Buckthorn are thin, dark yellow green above, paler and somewhat hairy on the lower surface with slender and hairy leaf stems; buds without scales and heavily haired; bark slightly furrowed, ashy gray sometimes marked by large dark blotches.

LINDEN FAMILY

TILLACEAE

Basswood is the only representative of the Linden family in this state. Other names for this tree are—Linden Tree, Linden, Whistlewood.

The tough inner bark of this species is sometimes used in the manufacture of mats, cords, coarse cloths, etc. The wood is valuable for cabinet work, in musical instruments and woodenware.

Key to Basswood Species

1. Leaves not heart-shaped at base 2
1. Leaves heart-shaped at base 3
2. Leaves thin, yellow green above, paler below, 3 to 4 inches long, 1¾ to 2 inches wide; stems slender and smooth; buds bright red; bark light grayish brown, smooth; found on coast *(Tilia littoralis).*
2. Leaves dark green, lustrous above, smooth below except rusty hairs on midrib, 3½ to 5½ inches long, 2 to 3 inches wide; stems slender, smooth; buds sharp pointed, smooth, dark dull red; bark smooth, reddish brown; found southwest Georgia—*(Tilia crenoserrata).*
3. Leaves hairy below 4
3. Leaves smooth below 5
4. Leaves deeply heart-shaped at base, thick, brown-green and smooth above, hairy below, 4 to 6 inches long, 3¼ to 5 inches wide; leaf stem stout, smooth; smaller branchlets hairy, stout and reddish brown in color; found in Savannah river valley, from Augusta southward—*(Tilia lasioclada).*
4. Leaves dark green, smooth above, white hairy below, 3¼ to 5¼ inches long, 2¼ inches wide; branchlets brown hairy; stems slender and smooth; buds smooth and flattened; found on Piedmont Plateau of Georgia—*(Tilia heterophylla).*
5. Leaves thick or leathery, dark dull green, lustrous on lower surface, 5 to 6 inches long, 3 to 4 inches wide; stems slender, smooth; buds dark red; bark light brown and furrowed; found in mountains, rare—*(Tilia americana).*
5. Tree found in southern part of state 6
6. Leaves silvery below, deeply heart-shaped at base, thin, smooth and yellow green above, 3½ to 5 inches long, 2½ to 3½ inches wide; leaf stems slender and smooth; buds dark brown, smooth—*(Tilia floridana).*
6. Leaves not silvery below, or deeply heart-shaped at base.... 7
7. Leaves slightly heart-shaped at base, dark yellow green, lustrous above, paler below, 2¾ to 4½ inches long, 4½ to 2½ inches wide; stems stout and smooth; buds wide, smooth; bark reddish brown; branchlets sometimes hairy—*(Tilia caroliniana).*
7. Leaves usually heart-shaped, sometimes not thick, dull yellow green, smooth above, sometimes slightly hairy below, 2½ to 4 inches long, 2 to 3 inches wide; leaf stems slender and hairy; buds rusty brown hairy; branchlets pale first year, dark reddish brown second year; tree rare—(*Tilia georgiana).*

Tilia heterophylla var. Michauxii found rarely in the mountains of northern Georgia.

Tilia georgiana var. crinata, sometimes known as *Tilia pubescens,* distinguished by its thickly matted hairs; found near mouth of Midway river in southern Georgia.

CAMELLIA FAMILY

THEACEAE

This tree family is one of the most interesting in the state. William Bartram, in his travels through several states in the southeast, 1773-78, found this plant. He brought cuttings out of the Altamaha swamp, where it was found and from these cuttings, trees of this kind are found in cultivated state over the world. It was said it was found again in 1790, but has not been seen in wild state since then, though many scientists have searched for it. This tree is Gordonia *(Gordonia alatamaha)*, sometimes called *Franklinia*. Bartram, who thought it was an entirely new species named it after Benjamin Franklin *(Franklinia alatamaha)*. This plant is sometimes known as *Gordonia pubescens, L'Her.* Thus this plant is veritably the lost tree of Georgia.

Gordonia lasianthus, known as Loblolly Bay, is common in the southern portion of the state.

Description of the two species is as follows:

Loblolly Bay *(Gordonia lasianthus)* — Leaves leathery, notched widely above the middle, dark green, lustrous and smooth, 4 to 5 inches long, 1½ to 2 inches wide; leaf stems stout, winged toward apex; buds covered with pale, silky hairs; bark divided into rounded ridges with shallow fissues.

Frankalinia *(Gordonia alatamaha)* — Leaves with teeth remotely serrate above middle, bright green above, paler below, 5 to 6 inches long, 1½ to 2 inches wide; leaf stems stout, wing margined above; buds compressed, reddish brown and hairy; bark smooth, thin, dark brown.

NOTE — Description of the *Gordonia alatamaha* is given of this species in cultivation.

GINSENG FAMILY

ARALIACEAE

In this family of herbs, vines, shrubs and trees, perhaps the most commonly known of them all is the English Ivy vine *(Hedera helix)*. The only tree representative in this state, however, is commonly called Prickly Ash or Hercules' Club *(Aralia spinosa)*. The common Ginseng, a small plant with very valuable roots, is also commonly known member of the family that bears its name.

The distinguishing characteristic of this tree is that the leaves on a single plant may be one, two and three times compound. These leaves are large, sometimes being several feet in length and over half as wide. The twigs and branches are armed with stout, short thorns, and the twigs are roughened by many leaf scars. The wood is very brittle. The branchlets are pithy. Medicine is sometimes made from the bark and berries.

BLACKGUM FAMILY

NYSSACEAE

None of the Black Gum species found in Georgia are important, but are used to some extent in the manufacture of paper and veneer.

All four species occur in swamps, and the *sylvatica* has been found on hillsides, far from water.

This family of trees is confined to eastern North America, western China, Thibet, the Himalayas and the Malay Archipelago, a fact that makes it interesting.

Key to Blackgum Species

1. Leaves thick and firm, dark green, lustrous above, pale and often hairy below; 2 to 5 inches long, ½ to 3 inches wide; leaf stems bright red, slender; buds bright red; bark light brown with deep fissues; found common and scattered throughout the state—Blackgum *(Nyssa sylvatica).*
1. Leaf stems stout, usually grooved 2
2. Leaves thick and firm, dark green lustrous above, pale and slightly downey below, sometimes slightly scalloped, 5 to 7 inches wide; leaf stems hairy; buds bright yellow nearly imbedded in bark; bark thick, light to dark brown slightly roughened by scales; found in swamps from the middle Piedmont to the cost—Tupelo Gum *(Nyssa aquatica).*
2. Leaves smooth below, not scalloped; buds not yellow; leaf stems smooth; found in vicinity of coast 3
3. Leaves dark yellow green, lustrous above, paler below, 2 to 4 inches long, ¾ to 1 inch wide; buds dark reddish brown; bark gray to dark reddish brown—Water Gum *(Nyssa biflora).*
3. Leaves thick and firm, dark green lustrous above, paler below, 4 to 6 inches long, 2 to 2½ inches wide; leaf stems grooved; buds heavy hairy, bright red; bark dark brown with small platelike scales—Ogeechee Lime *(Nyssa ogeche).*

DOGWOOD FAMILY

CORNACEAE

One genus with three main species are represented in this state. The flowering dogwood is perhaps the best known, being distinguished in the spring by its snow white involucre that is commonly thought to be its flower, but the true flower is in the heart of this involucre. The wood of this species is valued where hardness is required, and is used in making spindles, bobbins and other mill supplies. It is used as an ornamental tree and planted over the entire state.

The other two species are not as well known as the one mentioned above, but are also attractive.

Key to Dogwood Species

1. Leaves alternate, usually clustered at ends of branch, with few hairs on upper surface, whitish and covered with hairs on lower surface; leaf stems slender, grooved—Alternate Leaf Dogwood *(Cornus alternifolia).*
1. Leaves opposite 2

2. Leaves pale, slightly hairy and white on lower surface; leaf stems grooved, smooth; red berries persistent on tree; twigs bright red or greenish—Flowering Dogwood *(Cornus florida)*.
2. Leaves thin, pale, roughened by short hairs on the lower surface; stems stout, grooved and hairy; stems duller color; fruit a cluster of dark blue berries; twigs duller color than above—Blue Dogwood *(Cornus asperifolia)*.

Cornus florida var. rubra A. with pink involucre, sometimes appears.

HEATH FAMILY

ERICACEAE

In this family the Sourwood is the only one of the genera that attains a size larger than a shrub in Georgia. Among the best known of this family are the Azalea, Huckleberries, Laurel and Rhododendron.

Laurel and Rhododendron are both used for ornamental purposes. They are, however, found wild throughout the mountains and from the middle to the upper Piedmont Plateau. Where they are in profusion, they attract much attention at blossoming time.

Key to Heath Species

1. Leaves thin 2
1. Leaves thick, leathery and usually firm 3
2. Leaves dark green, smooth above, pale and hairy below, especially on yellow midrib; 3 to 4 inches long, 1 to 1½ inches wide; stems slender, flattened; buds chestnut brown, white hairy near apex; bark thin, smooth, pale gray; found near Savannah—Laurel *(Elliottia racemosa)*.
2. Leaves toothed, thin, with sour taste, green lustrous above, few scattered hairs below, 5 to 7 inches long, 1½ to 2½ inches wide: stems round, smooth; buds dark red; bark light gray, deeply furrowed; found in upper Piedmont Plateau and mountains. Sourwood *(Oxydendrum arboreum)*.
3. Plants shrubby, found in mountains, leaf stems grooved or flattened 4
3. Plants found over the state; leaf stems very short or absent; when present, rounded 5
4. Leaves thick, leathery, dark green and lustrous above, pale or whitish below, 4 to 12 inches long, 1½ to 2½ inches wide; stems stout, ridges above, rounded below; buds pointed, light green, smooth; bark light reddish brown. Rhododendron *(Rhododendron maximum)*
4. Leaves thick and ridged, dull green above, light yellow green below, 3 to 4 inches long, 1 to 1½ inches wide; leaf stems slightly flattened; buds light green with scant white hairs; bark dark brown tinged with red. Mountain Laurel *(Kalmia latifolia)*.

5. Leaves thick and firm, pale green, lustrous above with pale scales below, 1 to 3 inches long, ¼ to 1½ inches wide; leaf stem thick; buds minute, acute with rusty scales; bark reddish brown divided into ridges; tree of the coast. Lyonia, sometimes called Prickly Ash *(Xolisma ferruginea)*.
5. Leaves leathery, dark green, lustrous above, pale below, ½ to 2½ inches long; ½ to 1 inch wide, stem of leaf very short or absent; buds chestnut brown; bark dark red brown; found scattered over state. Sparkle Berry *(Vaccinium arboreum)*.

NOTE—A Purple Rhododendron *(Rhododendron catawbiense)* is found near the tops of some of the mountains in northern Georgia.

SAPODILLA FAMILY
(SAPOTACEAE)

Three species of Bumelia are found in Georgia in the southern part of the state. These are Black Haw *(B. tenax)*, Southern Buckthorn *(B. lycoides)*, and Chittamwood *(B. lanuginosa)*.

It may be interesting to note that Bumelia was once the scientific name of the ash. The species is of no commercial importance.

Key to the Bumelia

1. Leaves somewhat pointed, bright green and smooth on the upper surface, light green and sometimes covered with pale hairs below, 3 to 6 inches long, ½ to 2 inches wide; leaf stems slender, slightly grooved, sometimes smooth; buds minute, dark brown, nearly immersed in bark; bark thin red brown and smooth. Southern Buckthorn *(Bumelia lycioides)*.
1. Leaves rounded, dark green above, covered on lower surface with hairs; bark dark brown and divided into ridges.................. 2
2. Leaves thin, dull green above, covered with rusty hairs below, 1 to 3 inches long, 1 to 1½ inches wide; stems slender, hairy grooved; buds minute, rusty and hairy; bark with wide flat ridges. Black Haw *(Bumelia tenax)*
2. Leaves thin, lustrous above, covered with rusty brown and sometimes silvery white hairs below, 1 to 2½ inches long, 1-3 to ¾ inch wide; leaf stems slender; bark dark gray brown, divided into narrow ridges. Chittamwood *(Bumelia lanuginosa)*.

EBONY FAMILY
(EBENACEAE)

Persimmon is the only representative of this family in Georgia. Persimmon is used where hard wood is required, as in the manufacture of saddletrees, shuttles, bobbins, golf heads and mallets. The fruit of this tree has a sweet and agreeable taste.

It is interesting to note that this family produces some of the valuable ebony of commerce, and also commercial food stuffs.

The leaves of the persimmon are leathery, smooth, dark green and lustrous on the upper surface, paler on the lower surface, with

stout and sometimes slightly hairy leaf stems. The buds are dark red-brown or purple and lustrous. The bark is broken into dark gray, thick, square plates sometimes tinged with red or brown; the inner bark is bitter.

Persimmon—*(Diospyros virginiana).*

STORAX FAMILY
STYRACACEAE

The Silverbell and Sweetleaf are the common representatives of this family in Georgia. The wood of the species is not commercially important. It makes a very pretty shade tree and is quite attractive when in bloom.

Key to Storax Genera and Species

1. Leaves thin, pale green above, very hairy below, leaf stems very hairy; branchlets not pithy; buds hairy; bark close, smooth, dark reddish-brown; tree found on coast. Sweetleaf *(Styrax grandifolia).*

1. Leaves thicker, dull green above; stems not very hairy; buds not very hairy; bark not smooth; branchlets pithy.......... 2

2. Tree found in the northern part of the state in the mountains; bark in loose reddish-brown plates; leaves dull, dark green above, pale below; leaf stems smooth; buds bright red. Silverbell *(Halesia monticola).*

2. Tree found in central and southern portions of state; bark divided by fissues into ridges, not plated; leaf stems hairy.. 3

3. Leaves dark yellow-green above, pale below; leaf stems slightly hairy; buds dark red; bark reddish-brown. Silverbell *(Halesia carolina).*

3. Leaves thin, light green above, paler and hairy below; stems slender; buds light red and hairy; bark brown tinged with red; found only in extreme southern part of state. Silverbell *(Halesia diptera).*

SYMPLOCUS FAMILY
SYMPLOCACEAE

One genus having about 300 species belongs to this family. Sweetleaf or Horse Sugar *(Symplocos tinctoria)* is found in Georgia.

The leaves are leathery, dark green and lustrous on the upper surface, paler and hairy below, 3 to 5 times as long as wide; leaf stems stout and slightly winged. The buds are light green, sometimes hairy. The bark is ashy gray slightly tinged with red, sometimes roughened by fissues or warty projections.

The leaves are sweet to the taste and are desirable as food for cattle and horses. Both leaves and bark produce a yellow dye. The roots are bitter and aromatic and are sometimes used in making a domestic tonic. Widely distributed over the entire state.

OLIVE FAMILY

OLEACEAE

Perhaps the two best known members of this family are the Ash and the Tea Olive. The Ash is valued as lumber for handles, athletic goods and for other commercial purposes. The Tea Olive is used as an ornamental plant. The tiny, fragrant flower of the Chinese Tea Olive *(Osmanthus fragrens)*, is used by Chinese to perfume tea. This species is also used as an ornamental shrub in Georgia.

Key to Olive Genera

1. Leaves compound, with an unequal number of leaflets, leaflets usually notched, compressed terminal buds much larger than lateral buds; bark light gray, deeply furrowed. Ash *(Fraxinus)*.
1. Leaves not compound 2
2. Leaves thin, yellow green on upper surface, paler on lower surface; stems slender, often winged above middle; bark close, slightly ridged, dark brown; buds small. Swamp Privet *(Forestiera acuminata)*.
2. Leaves thick and firm, dark green lustrous above; leaf stems stout, not winged 3
3. Leaves pale below; buds light brown, hairy; bark in tiny brown scales tinged with red; leaves large. Fringe Tree *(Chionanthus virginica)*.
3. Leaves lustrous below as well as above; buds reddish brown; bark dark gray in tiny scales which in dropping disclose an inner bark of cinnamon red. American Tea Olive *(Osmanthus americanus)*.

Key to Ash Species

1. Leaflets 5, rarely 3 or 7 in number........ 2
1. Leaflets 7 to 9 in number, rarely 5........ 3
2. Leaflets broad with rounded appearance, thick and firm, dark green above, paler, sometimes yellow green below; 3 to 6 inches long, 2 to 3 inches wide; leaf stems stout; buds chestnut brown, smooth; bark light gray, marked with large irregular patches; found in vicinity of coast. Swamp Ash *(Fraxinus caroliniana)*.
2. Leaflets thick and firm, dark green above, hairy below, 3 to 4 inches long, 1 to 1¼ inches wide; stems stout; buds rusty and hairy; bark light gray; found in southern part of state. Water Ash *(Fraxinus pauciflora)*.
3. Leaves thick and firm, dark green, lustrous above, hairy below especially on yellow midrib, 3 to 6 inches long, 1¼ to 2 inches wide; leaf stems stout, usually hairy; buds light brown, hairy; bark rough, dark gray, slightly furrowed; found in mountains of northern Georgia. White Ash *(Fraxinus biltmoreana)*.
3. Leaves thin, midrib not yellow........ 4

4. Leaves dark green above, pale green or slightly hairy below, 3 to 5 inches long, 1½ to 3 inches wide; leaf stems stout, grooved; buds rusty hairy; bark dark brown or reddish-gray, divided into broad flat ridges; tree found over entire state. White Ash *(Fraxinus americana).*
4. Leaves light yellow-green above, hairy below with silky hairs, 4 to 6 inches long, 1 to 1½ inches wide; leaf stems slightly grooved, hairy; buds hairy; dark brown tinged with red, slightly furrowed; found in northern and central Georgia. Red Ash *(Fraxinus pennsylvanica).*

Hybrids of Ash

Fraxinus Smallii (Variant of White Ash) *(F. americana)* and Red Ash *(F. pennsylvanica).*
Fraxinus pennsylvanica var. lanceolata (Variant of Red Ash).

FIGWORT FAMILY
SCROPHULARIACEAE

The Figwort family has only one species of the tree size of vegetation in this state. This is the Paulownia tree. It might be interesting to note that this tree was named for Princess Anna Paulownia, of Russia. Its main characteristic is that of having large catalpa-like leaves, with 3 at a node instead of 2, as has the catalpa as shown in the general key to the families. This tree also has the unique characteristic of having small boles that look like cotton boles. These are clustered and are persistent in clusters in the tree for a large part of the year and sometimes for the entire year.

Some of the other representatives of this family are found among common flowers as Mullen, Fox Glove and Snap Dragons. The tree form of this family was introduced and has escaped into the forest. It is found scattered around the edges of towns and farm settlements.

Paulownia *(Paulownia tomentosa).*

BIGNONIA FAMILY
BIGNONIACEAE

The Bignonia Family produces only one genus with two species in this state. These are both known as "Catalpa" or "Indian bean". The family is of no commercial importance in the state, though it is frequently planted as a shade tree.

Key to Catalpas

1. Leaves 5 to 6 inches long, 4 to 5 inches wide; buds bright green, hairy; bark light brown with thin irregular scales; a tree of the southern portion of the state. *Catalpa bignonioides.*
1. Leaves 10 to 12 inches long, 7 to 8 inches wide; buds chestnut brown, slightly hairy; bark darker brown than above with thin scales; found in the northern portion of the state. *Catalpa speciosa.*

MADDER FAMILY

RUBIACEAE

Two genera are found in the state. Each one has one species. South American trees yielding quinine from their bark are numbered among this family. Neither of the two trees found in this state are of any commercial importance.

Key to Madder Genera and Species

1. Leaves dark green above, paler below, slightly hairy on both sides; leaf stems stout and covered with slight hairs; bark light brown, bitter in taste; buds dark red brown, minute and nearly immersed in bark; small tree, found on coast, rare. Georgia Bark *(Pinckneya pubens).*

1. Leaves thin, dark green above, pale and smooth or slightly hairy below, stout yellow midrib often covered with long white hairs; leaf stems stout grooved and smooth; bark dark gray brown and often nearly black, divided into broad, flat plates; buds minute, nearly immersed in bark, found over state, common. Button Bush *(Cephalanthus occidentalis).*

HONEY SUCKLE FAMILY

CAPRIFOLIACEAE

The Honey Suckle Family is represented in Georgia in its tree form only as a Black Haw or Viburnum. There are three species in the genus Viburnum. No commercial value is attached to the Black Haw except as an ornamental tree.

Key to Black Haw Species

1. Leaves thick, dark green above, pale below, 4 to 6 inches long, ½ to 2 inches wide, stems slender; buds reddish brown with rusty scales; found over entire state. Black Haw *(Viburnum nudum).*

1. Leaves less than 4 inches long, always wider than ½ inch, generally rare and local 2

2. Leaves leathery, dark green, smooth above, pale below, 1 to 3 inches long, ½ to 3 inches wide; stems grooved, sometimes winged; buds brown, sometimes scaly; bark red brown thickly scaled; tree found in eastern Georgia (rare). Black Haw *(Viburnum prunifolium).*

2. Leaves leathery, dark green above, pale below, 3 inches long, ½ to 3 inches wide; stems stout, yellow; buds thickly hairy; bark ridged, divided by cross fissues, dark brown; wood has a repulsive odor. Rusty Black Haw *(Viburnum rufidulum)* *Viburnum nudum var. angustifolium*, a variant of *V. Nudum*, may be distinguished from the latter by its smaller leaves.

LIST OF GEORGIA TREES BY FAMILIES

NOTE: While some of the following species given do not attain tree size in Georgia, they are listed as arborescent vegetation by the authorities.

PINE FAMILY

(PINACEAE)

Common Name	Scientific Name
White Pine	*Pinus strobus*
Shortleaf pine	*Pinus echinata*
Loblolly pine	*Pinus taeda*
Slash pine	*Pinus caribaea*
Longleaf pine	*Pinus palustris*
Pitch pine	*Pinus rigida*
Pond pine	*Pinus serotina*
Spruce pine	*Pinus glabra*
Scrub pine	*Pinus virginiana*
Table mountain pine	*Pinus pungens*
Sand pine	*Pinus clausa*
Red spruce	*Picea rubra*
White cedar	*Chamaecyparis thyoides*
Red cedar	*Juniperus virginiana*
Southern red cedar	*Juniperus lucayana*
Hemlock	*Tsuga canadensis*
Carolina hemlock	*Tsuga caroliniana*
Bald cypress	*Taxodium distchum*
Pond cypress	*Taxodium ascendens*

YEW FAMILY

(TAXACEAE)

Torreya	*Torreya taxifolia*

PALM FAMILY

(PALMAE)

Cabbage tree	*Sabal palmetto*

LILY FAMILY

(LILIACEAE)

Spanish bayonet	*Yucca aloifolia*
Spanish dagger	*Yucca gloriosa*

WILLOW FAMILY

(SALICACEAE)

Black Willow	*Salix nigra*
Black Willow	*Salix longipes*
Black Willow	*Salix longipes var. venulosa*
Harbison willow	*Salix Harbisonii*
Largetooth aspen	*Populus grandidentata*
Cottonwood	*Populus deltoides*
Swamp Cottonwood	*Populus heterophylla*
Silver poplar	*Populus alba*

SWEET GALE FAMILY
(MYRICACEAE)

Wax myrtle........*Myrica cerifera*

CORKWOOD FAMILY
(LEITNERIACEAE)

Corkwood ....*Leitneria floridana*

WALNUT FAMILY
(JUGLANDACEAE)

Butternut ....*Juglans cinerea*
Black walnut........*Juglans nigra*
White hickory........*Carya alba*
Water hickory........*Carya aquatica*
Shagbark hickory........*Carya ovata*
Shagbark hickory........*Carya ovata var. pubescens*
Southern shagbark hickory........*C. carolinae septentrionalis*
Hickory ....*Carya ovalis var. odorata*
Hickory ....*Carya ovalis var. obovalis*
Bitternut hickory........*Carya cordiformis*
Pignut hickory........*Carya glabra*
Pignut hickory........*Carya glabra var. magacarpa*
Pignut hickory........*Carya ovalis var. obcordata*
Pale hickory........*Carya pallida*
Pale leaf hickory........*Carya glabra var. villosa*
Pignut Hickory........*Carya ovalis*

BIRCH FAMILY
(BETULACEAE)

Alder ....*Alnus rugosa*
River birch........*Betula nigra*
Yellow birch........*Betula lutea*
Black birch........*Betula lenta*
Hornbeam ....*Carpinus Caroliniana*
Ironwood ....*Ostrya virginiana*
Hazelnut ....*Corylus americana*

BEECH FAMILY
(FAGACEAE)

Beech ....*Fagus grandifolia*
Chestnut ....*Castanea dentata*
Chinquapin ....*Castanea pumilla*
Chinquapin ....*Castanea alnifolia*
Chinquapin ....*Castanea alnifolia var. floridana*
White oak........*Quercus alba*
White oak........*Quercus austrina*
Chapman White oak........*Quercus Chapmanii*

Durand white oak	*Quercus Durandii*
Swamp white oak	*Quercus prinus*
Chestnut oak	*Quercus montana*
Yellow oak	*Quercus Muehlenbergii*
Post oak	*Quercus stellata*
Post oak	*Quercus stellata var, margaretta*
Bur oak	*Quercus microcarpa*
Overcup oak	*Quercus lyrata*
Northern red oak	*Quercus borealis maxima*
Shumard red oak	*Quercus Shumardii*
Spanish oak	*Quercus rubra*
Swamp spanish oak	*Quercus rubra var. leucophylla*
Turkey oak	*Quercus Catesbaei*
Scarlet oak	*Quercus coccinea*
Scarlet oak	*Quercus coccinea var. tuberculata*
Georgia oak	*Quercus georgiana*
Georgia oak	*Quercus Smallii*
Black oak	*Quercus velutina*
Black jack oak	*Quercus marilandica*
Blue jack oak	*Quercus cinerea*
Laurel oak	*Quercus laurifolia*
Water oak	*Quercus nigra*
Willow oak	*Quercus phellos*
Live oak	*Quercus virginiana*
Live oak	*Quercus virginiana var. geminata*
Shingle oak	*Quercus imbricaria*
Myrtle oak	*Quercus myrtifolia*
Hybrid	*Quercus caduca*
Hybrid	*Quercus carolinensis*
Hybrid	*Quercus dubia*
Hybrid	*Quercus subintegra*
Hybrid	*Quercus sublaurifolia*
Hybrid	*Quercus Ashii*
Hybrid	*Quercus Walteriana*
Hybrid	*Quercus rubra var. triloba*
Hybrid	*Quercus rubra var. pagodaefolia*
Hybrid	*Quercus Bushii*
Hybrid	*Quercus succulenta*

ELM FAMILY
(ULMACEAE)

Sugarberry	*Celtis laevigata*
Hackberry	*Celtis occidentalis*
Hackberry	*Celtis occidentalis var. canina*
Hackberry	*Celtis pumilla var. georgiana*
Water elm	*Planera aquatica*
Winged elm	*Ulmus alata*
White elm	*Ulmus americana*
Slippery elm	*Ulmus fulva*
Red elm	*Ulmus serotina*

MULBERRY FAMILY
(MORACEAE)

Red mulberry	*Morus rubra*
Paper mulberry	*Broussonetia papyrifera*
Osage Orange	*Maclura pomifera*

MAGNOLIA FAMILY
(MAGNOLIACEAE)

Yellow poplar	*Liriodendron tulipifera*
Cucumber tree	*Magnolia acuminata*
Yellow cucumber tree	*Magnolia cordata*
Mountain magnolia	*Magnolia Fraseri*
Large leaf cucumber tree	*Magnolia macrophylla*
Magnolia	*Magnolia grandiflora*
Mountain magnolia	*Magnolia pyramidata*
Umbrella tree	*Magnolia tripetala*
Laurel Magnolia	*Magnolia virginiana*

CUSTARD-APPLE FAMILY
(ANONACEAE)

Pawpaw	*Asimina triloba*

LAUREL FAMILY
(LAURACEAE)

Red bay	*Persea Borbonia*
Swamp bay	*Persea palustris*
Sassfrass	*Sassfrass officinale*

WITCH HAZEL FAMILY
(HAMEMELIDACEAE)

Witch hazel	*Hamamelis macrophylla*
Witch hazel	*Hamamelis virginiana*
Sweet gum	*Liquidambar styraciflua*

PLANE TREE FAMILY
(PLATANACEAE)

Sycamore	*Platanus occidentalis*

ROSE FAMILY
(ROSACEAE)

Service berry	*Amelanchier canadensis*
	Amelanchier laevis

Red haws	*Crataegus arborescens*
	Crataegus Boyntonii
	Crataegus Chapmanii
	Crataegus ingins
	Crataegus Sargentii
	Crataegus tomentosa
	Crataegus Virides
	Crataegus vulsa
Small red haw	*Crataegus spathulata*
Buck thorn	*Crataegus algens*
	Crataegus amnicola
	Crataegus collina
	Crataegus Mohrii
	Crataegus regalis
	Crataegus punctata
Sweet red haw	*Crataegus aprica*
	Crataegus dispar
	Crataegus flava
	Crataegus Ravenelii
	Crataegus tristis
Parsley haw	*Crataegus apiifolia*
Plum haw	*Crataegus georgiana*
Tree haw	*Crataegus drymophila*
Cockspur thorn	*Crataegus Crus-galli*
May apple	*Crataegus aestivalis*
	Crataegus rufula
Crab apple	*Malus angustifolia*
	Malus bracteata
	Malus coronaria var. elongata
Laurel cherry	*Prunus caroliniana*
Wild Cherry	*Prunus serotina*
Choke cherry	*Prunus virginiana*
Wild plum	*Prunus americana*
Chickasaw plum	*Prunus angustifolia*
Black sloe	*Prunus umbellata*
	Prunus umbellata var. injucunda
Wild plum	*Prunus munsoniana*

LEGUME FAMILY
(LEGUMINOSAE)

Red bud	*Cercis canadensis*
Honey locust	*Gleditsia triacanthos*
Water locust	*Gleditsia aquatica*
Kentucky coffee tree	*Gymnocladus dioicus*
Mimosa	*Leucanea pulverulenta*
Black locust	*Robinia pseudoacacia*
Clammy locust	*Robinia viscosa*
Yellowwood	*Cladrastis lutea*

RUE FAMILY
(RUTACEAE)

Prickly ash	*Xanthoxylum clava-Herculis*
Hop tree	*Ptelea trifoliata*

QUASSIA FAMILY
(SIMARUBACEAE)

Tree of Heaven	*Ailanthus glandulosa*

SUMACH FAMILY
(ANACARDIACEAE)

Dwarf sumach	*Rhus copallina*
Smooth sumach	*Rhus glabra*
Staghorn sumach	*Rhus typhina*
Poison sumach	*Rhus Vernix*

CYRILLA FAMILY
(CYRILLACEAE)

Ironwood	*Cyrilla racemiflora*
Titi	*Cliftonia monophylla*

HOLLY FAMILY
(AQUIFOLIACEAE)

Dahoon	*Ilex cassine*
Holly	*Ilex opaca*
Deciduous holly	*Ilex decidua*
Largeleaf holly	*Ilex monticola*
Cassena	*Ilex vomitoria*

STAFF TREE FAMILY
(CELASTRACEAE)

Wahoo	*Evonymus atropurpureus*

MAPLE FAMILY
(ACERACEAE)

Sugar maple	*Acer floridum*
Box elder	*Acer negundo*
White-bark maple	*Acer leucoduerme*
Striped maple	*Acer pennsylvanicum*
Red maple	*Acer rubrum*
	Acer rubrum var. tomentosum
	Acer rubrum var. tridens
Silver maple	*Acer saccharinum*
Sugar maple	*Acer saccharum*
	Acer saccharum var Schneckii

HORSE CHESTNUT FAMILY
(HIPPOCASTANACEAE)

Buckeye	*Aesculus discolor*
	Aesculus georgiana
	Aesculus georgiana var. pubescens
	Aesculus georgiana var. lanceolata
	Aesculus austrina
	Aesculus octandra
	Aesculus pavia
Horse chestnut	*Aesculus hippocastanum*
Fetid Buckeye	*Aesculus glabra*

SOAPBERRY FAMILY
(SAPINDACEAE)

Chinaberry	*Sapindus marginatus*

BUCKTHORN FAMILY
(RHAMNACEAE)

Indian cherry	*Rhamnus caroliniana*

LINDEN FAMILY
(TILIACEAE)

White basswood	*Tilia americana*
Basswood	*Tilia caroliniana*
	Tilia crenoserrata
	Tilia floridana
	Tilia georgiana
	Tilia georgiana var. crinata
	Tilia heterophylla
	Tilia heterophylla var. Michauxii
	Tilia lasioclada
	Tilia littoralis

CAMELLIA FAMILY
(THEACEAE)

Franklinia	*Gordonia alatamaha*
Loblolly Bay	*Gordonia lasianthus*

GINSENG FAMILY
(ARALIACEAE)

Prickly ash	*Aralia spinosa*

BLACKGUM FAMILY
(NYSSACEAE)

Tupelo gum	*Nyssa aquatica*
Black gum	*Nyssa sylvatica*

Ogeechee lime	*Nyssa ogeche*
Water gum	*Nyssa biflora*

DOGWOOD FAMILY
(CORNACEAE)

Alternate leaf dogwood	*Cornus alternifolia*
Purple dogwood	*Cornus asperifolia*
Flowering dogwood	*Cornus florida*
	Cornus florida var. rubra

HEATH FAMILY
(ERICACEAE)

Lyonia	*Xolisma ferruginea*
Laurel	*Elliottia racemosa*
Mountain laurel	*Kalmia latifolia*
Sourwood	*Oxydendrum arboreum*
Rhododendron	*Rhododendron maximum*
Purple rhododendron	*Rhododendron catawbiense*
Sparkle berry	*Vaccinium arboreum*

SAPODILLA FAMILY
(SAPOTACEAE)

Chittam wood	*Bumelia lanuginosa*
Buckthorn	*Bumelia lycioides*
Black haw	*Bumelia tenax*

EBONY FAMILY
(EBENECEAE)

Persimmon	*Diospyros virginiana*

STORAX FAMILY
(STYRACACEAE)

Silverbell	*Halesia carolina*
	Halesia monticola
	Halesia diptera
Sweetleaf	*Styrax grandifolia*

SYMPLOCUS FAMILY
(SYMPLOCACEAE)

Horse Sugar	*Symplocos tinctoria*

OLIVE FAMILY
(OLEACEAE)

American Tea Olive	*Osmanthus americanus*
Fringe tree	*Chionanthus virginica*
Swamp privet	*Forestiera acuminata*
White ash	*Fraxinus americana*
	Fraxinus Smallii
	Fraxinus biltmoreana
Red ash	*Fraxinus pennsylvanica*
	Fraxinus pennsylvanica var. lanceolata
Water ash	*Fraxinus pauciflora*
Swamp ash	*Fraxinus caroliniana*

FIGWORT FAMILY
(SCROPHULARIACEAE)

Paulownia	*Paulownia tomentosa*

BIGNONIA FAMILY
(BIGNONIACEAE)

Catalpa	*Catalpa bignonioides*
	Catalpa speciosa

MADDER FAMILY
(RUBIACEAE)

Buttonbush	*Cephalanthus occidentalis*
Georgia Bark	*Pinckneya pubens*

HONEYSUCKLE FAMILY
(CAPRIFOLIACEAE)

Black haw	*Viburnum nudum*
	Viburnum nudum var. angustifolium
	Viburnum prunifolium
Rusty black haw	Viburnum rufidulum

INDEX

INDEX TO COMMON AND SCIENTIFIC NAMES

March 1931 Bulletin ~~13~~ 14

Georgia Forest Service

B. M. LUFBURROW, *State Forester*

Forest Management for Naval Stores

By

H. M. SEBRING, *Assistant State Forester*

PROTECTION
CONSERVATION
PERPETUATION
GEORGIA
FOREST SERVICE

Forest Management For Naval Stores

H. M. SEBRING, *Asst. State Forester*

This bulletin is designed to offer a plan for managing longleaf and slash pines with a view to combining the production of naval stores with other forest products.

The practices of the naval stores industry in the past has been directed mainly to the production of gum and with little thought of other forest products. In this one should not condemn the naval stores operators as they were following methods in the woods that they conceived were in line with economic conditions. Radical changes in any industry are invariably brought about by economic pressure. In the past the naval stores operators were not obliged to practice scientific forest management because there seemed to be an unlimited supply of trees available for working, and conservative methods of operation might have resulted in loss.

We are now at a stage of the naval stores industry where the operator does not find an untouched source of raw material to move to when a crop has been worked out. The operator finds himself confined to his own or adjacent leased lands, and, in order to continue in business, this available forest land must be managed so as to have a continuous growth of thrifty timber insuring a perpetual source of raw material.

The naval stores industry in France is under intensive management, a system that was not developed overnight but through a process of economic evolution. Likewise in the southern pine belt systematic forest management will be developed slowly from crude beginnings. A system of forest management built up slowly on a sound business basis is bound to be more stable than an elaborate system adopted in a revolutionary manner.

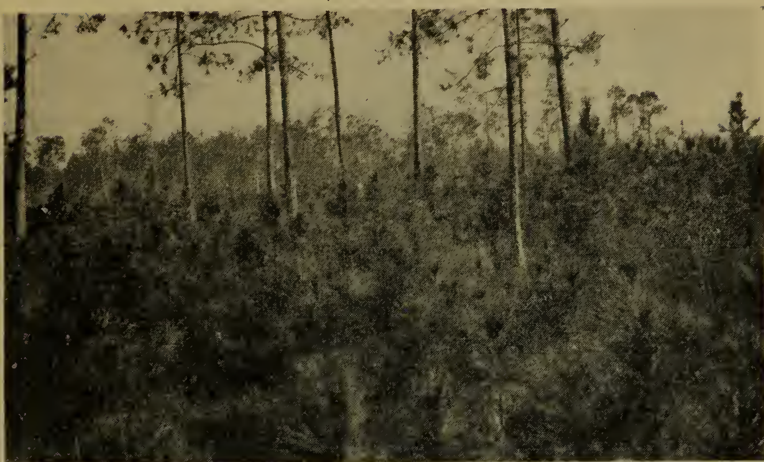
With this in mind, the writer is herein attempting to outline a few ideas in forest management that have been tried experimentally, the results of which seem to indicate the practicability of their application.

Many timberland owners are handling their properties primarily for naval stores, and begin working their trees whenever they reach a diameter of from 7 to 9 inches. All turpentine men realize that trees are retarded in height and diameter growth when worked, and that small trees after being worked from 6 to 8 years will not contain much wood of merchantable value. Such trees may be cut into small poles, crossties or cordwood but the profit from the wood of such trees will be negligible. It would be more profitable to manage so as to procure small dimension saw timber, large poles and piling in addition to naval stores. The yield from naval stores will not be decreased by such plan but prolonged and in most cases increased since a number of larger trees will be worked and yield more gum.

Prolonging the operation, of course, increases carrying charges, but subsequent logging operations will cover this. Diversified products will also enable the landowner to widen his markets and to be on a more stable economic basis in facing fluctuations in the demand for forest products.

FOREST PROTECTION

No intelligent plan of forest management can be practiced without some system of forest fire protection. The small number of trees per acre that the operators are working today is primarily due to annual grass fires that sweep over the land and kill most of the young trees that would have grown to turpentine size. The pine seedlings 2 to 12 inches high coming up through the grass are often overlooked by people who burn the woods. Seedlings and saplings above 2 feet in height can resist the fires better, but even among this class a large number are killed and the balance are held back at least a half in height growth.



Slash reproduction on cut-over land 2 miles east of Pearson, Ga. Land of H. F. Sears. North of Highway and Railroad. Protected for 3 years.

In addition to killing and retarding the growth of seedlings and saplings, fires retard the growth and, especially during very dry times, kill some of the larger trees. Then an inestimable damage is done to the soil. The natural ground cover of the woods, the leaves, dead branches, and litter, contain a natural fertilizer for trees. If allowed to decay this plant food becomes available to the trees, but if burned off the valuable plant food element, nitrogen, goes into the air with the smoke and the trees suffer for lack of it. Furthermore, the ground is robbed of a cover that is necessary to prevent excessive drying-out and that otherwise adds to the efficiency of the soil in stimulating growth.

The first essential, therefore, is fire protection. An important part of the work of the Georgia Forest Service is to assist timberland owners to protect their land from fire. This is accomplished mainly by forming timber protective organizations composed of landowners, each unit controlling at least 10,000 acres. Fire control methods will not be discussed in detail for other literature put out by the Georgia Forest Service covers protection in its entirety. The protection plan, briefly, covers

the construction of lookout towers and telephone lines for use in locating and reporting fires; the construction of fire breaks; the employment of men to carry out the protection plan; the purchase and use of fire fighting equipment; and educational work on fire prevention.

Fire Break along road and Slash Pine coming in beyond Fire Break. Protected 3 years. H. F. Sear's land, 5 miles east of Pearson, Ga., along south side of Highway Number 38.

Fire protection under the Georgia system will cost approximately 4 cents an acre per year, depending upon the acreage under protection, character of land protected and intensity of the fire season. This is a small investment when one considers the results accruing.

By the old practice of annual burning, the number of seedlings and saplings coming back is reduced to such an extent that turpentine operators are now working at any one time only an average of from 15 to 30 trees per acre, while they could work from 50 to 100 if their land had been protected and a management plan followed.

Sixty foot forest fire lookout tower, built of cypress by Reynolds Brothers Lumber Company, Albany, Ga., on Pine Island Timber Protective Organization.

Planting Pines

The reforesting of cut-over land by planting should be resorted to where natural seeding cannot be secured. If cut-over land averages three or four good healthy seed trees per acre there is no necessity for planting. All one must do is keep out the fires and nature will do the rest. Slash pine usually furnishes some seed every year, likewise longleaf pine; however, good crops of slash pine seed come every 2 to 3 years, and good crops of longleaf pine seed every 3 to 7 years. The cones, or burs, mature in the fall and immediately open, releasing the seed to reforest the land. Each seed is equipped with a wing and will often be carried by the wind several hundred yards from the tree.

Even if one must wait two or three years to get natural seeding, it is cheaper than to plant the land. One must often wait longer for long-leaf than for slash, because the former does not produce seed as often.

An advantage of planting over natural seeding is that a stand is assured immediately, and the trees will mature a little earlier. However, in the life of a stand of trees this difference in size is almost negligible.

Berry Rigdon's slash plantation at Harding, Tift county, Ga. Formerly old field. Planted 1928 using 2 year old stock dug from woods, with 6 by 12 feet spacing.

Where there are large open spaces devoid of seed trees, it will be necessary to plant. Frequently one will find tall, slender, small-topped trees, formerly part of a dense stand, left by the loggers as inferior timber. It is a question if such trees will produce enough seed to restock the land, especially if they are longleaf trees. In such cases it would probably be advisable to plant.

One year old seedlings, purchased from the Georgia Forest Service at cost of production or very carefully dug up in the woods, may be planted. One need plow only one or two shallow furrows with a middle-buster plow to prepare for each row

of seedlings. A spacing of 10 by 10 feet is recommended for slash and long-leaf pines—giving 435 trees per acre—necessitating plowing the planting furrows 10 feet apart. Total planting cost will amount to $3.00 to $4.00 per acre.

The owner cannot expect to grow advantageously so many trees per acre, but at least this many should be planted so as to have them crowded in the sapling stage. This will result in better height growth, shade out some of the lower limbs and make a cleaner trunk for naval stores work. When the stand shows evidence of too much crowding, some will have to be thinned out. This phase of management will be treated further on in this bulletin.

GENERAL DISCUSSION

In considering reforestation, it is well to remember that one does not have to wait 20 or 30 years before realizing a financial return. Nowhere in the turpentine belt of South Georgia will one find extensive areas of land without a scattering of trees varying in age from one year old seedlings to trees 40 years of age. One also finds a lot of scattered original growth left on the land which lumbermen considered inferior trees. A return from these scattered stands—which are sustaining many operators today—will pay taxes, protection cost, and even yield some profit until younger trees develop into workable size. Fire protection will increase the growth of the saplings already on the land and decrease the number of years the owner must wait for his trees to yield an income.

The age of a tree, as used in this publication, means the years from seed. Slash pine makes height growth the first year, but longleaf will not usually make appreciable height growth until it is three to four years old. For this reason, an 8-inch diameter longleaf pine will, under similar conditions, be 3 to 4 years older than a slash pine of the same diameter.

The diameter figures used in this bulletin are measurements 4½ feet from the ground. This is commonly called Diameter Breast High (D.B.H.).

The naval stores operators today are working an average of 15 to 30 trees per acre, which is much below the number of trees that could be worked if the land had been protected from fire and if selective turpentining had been carried on. Land protected and well managed will grow up and sustain at 20 to 25 years of age 250 to 300 trees per acre 7 to 9 inches or greater in diameter, in good healthy condition. This would give the owner from 50 to 75 trees per acre to work at one time and reduce turpentining costs by having the operation cover one-half to one-third less area.

Outline of Management Plan

The suggested management plan presented herein applies particularly to combining naval stores with other forest products and is discussed according to the following outline:

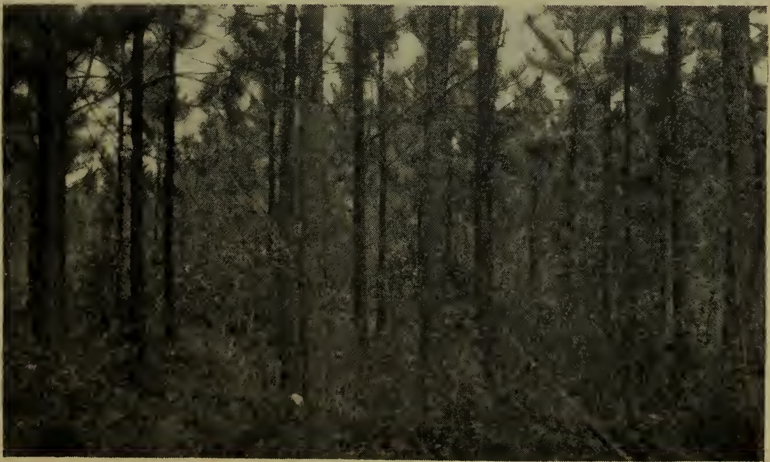
1. Thinning young stands to get required number of trees per acre.
2. Turpentining and then thinning 20-25 year old stands to stimulate growth. This will call for—
   a. Selecting trees to be left unworked as final stand.
   b. Selecting from the remainder the trees 9 inches and above that are to be worked and then removed; future working and removing trees as they reach 9 inches in diameter.
3. Working the final stand before removal.

Thinning Young Stands to Get Maximum Number of Trees Per Acre

Usually it is not necessary to thin until the saplings have reached a diameter of from 3 to 4 inches. This will be approximately 6 to 8 years of age for slash and 9 to 11 years for longleaf. Often on a typical slash pine site one will find 1,000 to

4,000 or more seedlings per acre coming in if the land is protected from fire. Where such is the case, they should be thinned to approximately 435 trees per acre, (approximately 10 by 10 feet spacing) when they have reached a height of from 6 to 8 feet.

As stated above, the first thinning will usually be needed when trees are 3 to 4 inches in diameter. At this time they will have reached a height of from 20 to 30 feet and will have shaded off some of the lower limbs. Then they should be thinned to from 200 to 300 trees per acre, or a spacing of from 12 to 15 feet apart. The number of trees that an acre of land will sustain up to a 7 to 9 inch diameter varies with the fertility and moisture content of the soil. The average forest soil will sustain about 250 trees per acre, while the most fertile soil will carry 300 trees up to a 7 to 9 inch diameter. Even if no market is found for these thinnings the expenditure of from $1.00 to $1.50 per acre for removals will be repaid by the accelerated growth of the remaining trees.



Ten year old natural growth slash pine on protected land at Coastal Plain Experiment Station, Tifton, Ga. Averages 1000 per acre 2 inches to 5 inches D. B. H. At proper age to thin to 300 trees per acre.

TURPENTINING AND THINNING 20-25 YEAR OLD STANDS TO STIMULATE GROWTH

A 20-year old stand of slash or a 25 year old stand of longleaf thinned when 3 to 4 inches in diameter and protected from fire will contain 200 to 300 trees per acre, 7 inches and above in diameter, and 45 to 50 feet in height. These figures are based on actual measurements of existing healthy stands of timber and are also in line with opinions of other foresters.

The following measurements are for a 1-4 acre representative plot of a 25 year old stand of Longleaf pine, 60 to 70 feet high, growing in Turner county under natural woods conditions:

Twenty-two year old longleaf pine Ichaway Plantation, Baker county. Thinned to 300 trees per acre. 100 trees per acre reserved for saw-timber and remainder will be worked for naval stores as they reach 9 inch size.

TABLE NUMBER 1

Diameter	Number of Trees on 1-4 Acre	Corresponding Number of Trees on 1 Acre
4 inches	1	4
5 "	10	40
6 "	13	52
7 "	16	64
8 "	11	44
9 "	13	52
10 "	7	28
11 "	2	8
Total	73	292

The stand shows some evidence of protection from fire prior to 1929. At that time trees 8 inches and up were cupped, one face to the tree. Since then the trees have been raked and the woods annually burned. The above figures show the stand has 198 trees 7 inches and up, out of a total of 292 trees per acre. Timber of this stocking is excellent for beginning management as outlined in this publication.

The following measurements are for a quarter-acre representative plot of a 21-year old stand of slash, growing in Ware county, that had never been subjected to fire:

TABLE NUMBER 2

Diameter	No. of Trees On 1-4 Acre	Corresponding No. of Trees On 1 Acre
Below 7 inches and averaging 4 inches	200	800
7 inches	13	52
8 inches	13	52
9 inches	7	28
10 inches	5	20
11 inches	6	24
Total	244 trees	976

These figures on an acreage basis would be 976 trees per acre, 176 of which were above 7 inches in diameter. If this stand had been thinned to 300 trees per acre, when they were from 3 to 4 inches in diameter, all of the trees would have averaged 7 to 9 inches in diameter. This is reasonable to assume because the cross-sectional (basal) area of 300 7 to 9 inch trees is less than the cross-sectional area of the 976 trees that stood on the acre. The cross-sectional or basal area of a stand of trees not thinned by man remains somewhat constant, after a certain age. In a thick stand of trees this basal area is represented by a large number of small and medium sized trees, while in a thin stand the basal area is represented by a smaller number of larger sized trees. It follows, therefore, that the larger the diameter of the trees the smaller number of trees per acre the owner will have at maturity.

The following table will approximately represent the number of trees an average acre of land will carry at the given diameter:

TABLE NUMRER 3

Diameter	Number of Trees Average Acre Will Carry
8 inches	371
9 inches	295
10 inches	236
11 inches	197
12 inches	164
13 inches	141
14 inches	121
15 inches	106
16 inches	93
17 inches	82
18 inches	76

The following figures are for a one-half acre representative plot of a 26-year old field stand of slash pine near Cogdell, Georgia:

TABLE NUMBER 4

Diameter	Number of Trees On 1-2 Acre	Corresponding Number of Trees On 1 Acre
5 inches	1	2
6 inches	47	94
7 inches	105	210
8 inches	71	142
9 inches	39	78
10 inches	17	34
11 inches	2	4
12 inches	5	10
Total	287	574

Trees 9 to 12 inches in diameter, turpentine size, numbered 63, or 126 per acre.

On an acreage basis this stand represented 574 trees, 126 of which were 9 inches and above, consequently of turpentine size. This stand, like the preceding one in Ware county, has a basal area far in excess of a stand of 7 to 9 inch trees at 300 trees per

Thick stand Longleaf Pine averaging 250 trees per acres 5 inches to 10 inches D. B. H. 25 years of age. Good stand for beginning selective turpentine management.

acre. It is, therefore, reasonable to assume that if the stand had been thinned at the proper size, to 300 trees per acre, there would have been at an earlier age about 200 trees 9 inches and above. Without thinning, it has 126 trees 9 inches and above, so certainly with thinning an estimate of 200 trees 9 inches and above and 100 below 9 inches is not excessive.

From the preceding discussion it will be evident that, depending upon soil and climatic conditions, a 20-year old stand of slash and a 25-year old stand of longleaf will, if managed according to recommendations, contain from 200 to 300 trees per acre 7 to 9 inches in diameter and above.

Here the plan of management recommended diverges from the usual plan of naval stores operators. They usually hang

cups on every tree as it reaches the minimum diameter they are using, which is often below the 9-inch minimum herein recommended. The result is that they are always working small sized trees, which means correspondingly small yields and a retarding of the growth of the trees, leaving very little merchantable material after the turpentine operation is completed.

The following table will clearly show that it would be more profitable to reserve some trees for working at larger diameters:

TABLE NUMBER 5

Calculated yield of turpentine, in barrels of spirits per crop, from second-growth longleaf and slash pines of various diameters at U. S. Forest Experiment Station, Starke, Florida, 1925

Diameter of tree at breast-height	Yield from longleaf pine[1]	Yield from slash pine[2]	Diameter of tree at breast-height	Yield from longleaf pine[1]	Yield from slash pine[2]
Inches	Barrels	Barrels	Inches	Barrels	Barrels
6	15.3	20.3	11	50.0	50.3
7	22.2	26.2	12	56.9	56.2
8	29.4	32.2	13	64.1	62.2
9	36.2	38.4	14	70.9	68.4
10	43.1	44.4			

1. Vigorous trees only. Second-year work, one face per tree (trees over 10½ inches cupped 15 years previously), chipped one-half inch, 33 streaks.
2. Vigorous trees only. First-year work, one face per tree, chipped one-half by one-half inch, 33 streaks.

By setting aside certain trees to attain a greater diameter the landowner will not only be getting a greater net return for his gum, but subsequent to the naval stores operation, he will have trees suitable for large size poles, piling or small size saw-mill timber.

SELECTING TREES TO BE UNWORKED TO MAKE UP FINAL STAND

The number of trees to be unworked will depend upon the size the owner wishes. This can be approximately determined by referring to the preceding table Number 3, where the approximate number of trees an acre will carry at a given diameter, are presented.

Assume there is a 20-year old stand of slash pine 7 inches and above in diameter, standing 250 trees per acre, and in the final stand 16-inch trees are desired. Table No. 3 shows that approximately 93 trees 16 inches in diameter can stand, in a healthy condition, on an acre of land. Hence, there are 157 trees per acre to be worked for naval stores and thinned out to give the 93 a chance to develop into 16-inch trees. The owner should go into his stand and at an average spacing of 22 by 22 feet (representing 93 trees per acre) select and mark the trees to be left.

SELECTING FROM THE REMAINDER TREES 9 INCHES AND ABOVE TO BE WORKED AND THEN REMOVED; FUTURE WORKING AND REMOVING TREES AS THEY REACH 9 INCHES IN DIAMETER

Based on a preceding assumption, there are 157 trees per acre to be thinned out, after being worked for naval stores. Some of these trees will not be 9 inches in diameter and should be reserved for a second or third working. About 50 trees 9 inches and above in diameter should be worked hard from 4 to 5 years and then removed. A stand of 250 7- to 9-inch trees per acre will begin to retard growth. The remaining 107 trees should be worked rather conservatively, approximately half of them at a time with 3 to 4 years to a face and then given one or two years' rest before back-facing. After half of the 107 trees have been worked 7 to 8 years, they should be removed, leaving approximately 50 more to be worked before there remains a final stand of 93 trees.

At this point the stand will be approximately 35 years old for slash and 40 years old for longleaf, and will be standing 143 trees to the acre. Table No. 3 shows that these 143 trees should be from 12 to 13 inches in diameter. Remembering that 93 trees are to be left to reach a 16-inch diameter, there would be 50 trees to be worked and thinned to give space to this final stand. These 50 trees will be 12 to 13 inches in diameter and should give a generous yield, as shown by Table No. 5. The 50 trees should be worked conservatively over a 10-year period, 4 years on a face, giving the tree a year or two of rest before back-facing. At the time of thinning this last group, the stand will be about 45 years old for slash and 50 years old for longleaf. The 93 trees making up the final stand should be approximately 14 inches in diameter and in 6 more years will undoubtedly have attained the desired 16-inch size. At the age of 50 to 55 years (slash and longleaf respectively) the stand will be ready for the final cutting.

Before discussing the disposal of the final stand, I am giving figures Dr. Austin Cary, of the United States Forest Service, Starke, Florida, obtained in two years' work on a slash pine stand similar to the assumed stand in the foregoing discussion. The writer assisted Dr. Cary in carrying out this experiment during the first year. The stand was 20 years old, having been thinned to 264 trees per acre some years before, and was in good condition when the experiment was begun. Dr. Cary selected 114 trees per acre to make up the final stand and immediately began working all of the remaining 150 trees. He contemplates working them for 6 years—3 years on a face—and then cutting them out to leave the 114 trees to grow to saw-timber size. The figures for the yield from these 150 trees for 1929 and 1930 are as follows:

Yield 1929—32 Streaks	Yield on Basis of 10,000 Faces
50 faces mostly below 9 inches D.B.H.	32 bbls. of spirits
100 faces mostly 9 in. and above D.B.H.	38 bbls. of spirits
Average yield for crop of 10,000 faces	36 bbls. of spirits

Yield 1930—33 Streaks	Yield on Basis of 10,000 Faces
50 faces mostly below 9 inches D.B.H.	33 bbls. of spirits
100 faces mostly 9 in. and above D.B.H.	40 bbls. of spirits
Average yield per crop of 10,000 faces	38 bbls. of spirits

It will require 4 more years to get complete records on this experiment, yet the figures to date indicate that the 150 trees per acre are yielding a profit; and when they are cut out there will still be 114 good trees on the acre for saw-mill purposes.

Working the Final Stand Before Removal

Considering the price of stumpage, or the running foot for poles and piling, it might be advisable not to turpentine the remaining 93 trees. The use of this final stand will depend upon market conditions and the owner's choice. In any event, the remaining stand of timber should average 10,000 to 15,000 board feet per acre.

Conclusions

This discussion covers stands of timber that have been given fire protection and not subjected to annual burning or what is called "controlled burning". Furthermore, it covers thick stands that are fairly even-aged, such as one will get under systematic fire protection.

To follow the plan recommended will not require a 20-year period before a return can be realized. Almost every naval store operator can find stands where he can begin following this plan and derive immediate returns.

Under the plan of management recommended, the timber will be in a healthy condition all of the time, and will be rapidly reaching the 9-inch working minimum. A 50 to 60 year rotation for his trees does not mean he will have to wait that long, for the first return will come at 20 to 25 years from planting and most owners already have a large amount of young timber soon reaching that age.

No inflexible rules for management have been advanced. The owner can vary his plans as the class of his timber and his needs dictate. An attempt has only been made to advance some plan of selective turpentining so as to raise in the turpentine belt other products of the forest than naval stores, impossible where all are worked as soon or before they are 9 inches in diameter.

APPENDIX

The writer is indebted to Dr. Austin Cary, of the United States Forest Service, Starke, Florida, for advancing some of the ideas on selective turpentine management; also for permission to use the gum yield figures on his management experiment at Starke, Florida.

Acknowledgement is also given to the Starke branch of the Southern Forest Experiment Station, United States Forest Service, for gum yields of slash and longleaf pines of various diameters. (Table No. 5).

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Georgia Forest Service

B. M. LUFBURROW, *State Forester*

Forests of Georgia Highlands

Their Importance for Watershed Protection, Recreation and Wood Production

By

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Georgia Forest Service and
Georgia Agricultural Experiment Station
Cooperating

TABLE OF CONTENTS

Foreword

Bonnell H. Stone, Blairsville, consulting forester, who has been field representative of state interests in this project, has contributed a foreword to this bulletin as follows:

A cooperative forestry research project was inaugurated in Georgia in 1930 in which the Appalachian Forest Experiment Station of the United States Forest Service, at Asheville; the Georgia State Board of Forestry, and the Georgia Agricultural Experiment Station joined. Georgians will be glad to know that this cooperative project was made possible by a special federal appropriation sponsored by Hon. Wm. J. Harris, Senior United States Senator of Georgia.

From the mountain branch of the Georgia Experiment Station in Union county where the work started, the forest studies are reaching out to the nearby national forests and to other lands where research plots are being established.

The bulletin covers observations made during the first year's survey. The facts herein reported will give an enlarged vision of the value of forests in the mountains of Georgia, not only with respect to their possibilities in producing timber but as to their value for watershed protection and recreation. In fact, when one considers the importance of a water supply for hydroelectric power and the effect of well managed forests on the conservation of water, both for water power and for preventing soil erosion losses, we find that watershed protection is perhaps the major public service rendered by mountain forests. Possibly second in importance in public benefits derived from the mountain forests is the ideal condition forests create for recreation in this highland playground of Georgia. Third in rank of value to the state is perhaps the timber produced by the forests.

The threefold value of the mountain forests emphasizes the great necessity of so managing them as to get the largest benefits to the state. To do this, it is necessary to know what the conditions are and what can be done to improve them. This means research. It is a pleasure to refer here to the keen interest manifested by the director of the Georgia Experiment Station and the state forester in this cooperative undertaking, and to the painstaking work of the personnel of the Appalachian Forest Experiment Station. The first results of forest research embodied in this bulletin, we feel, make a valuable contribution to the development of the State.

BONNEL H. STONE.

Mountain Forests of Georgia

The mountain region of Georgia holds a significant place in the economic geography of the state because of three important considerations: (1) Municipal water supply and hydroelectric power, (2) increasing public demand for recreational facilities, and (3), the continuous requirements for hardwood forest products. The basis for all these considerations is the proper development and management of the mountain forest land. The purpose of this bulletin is to present information pertinent to the nature and composition of the mountain forests of north Georgia, with such facts as are available concerning their proper development and management.

The Appalachian Mountains, which begin in Georgia, extend northward for over 1,000 miles. The portion of these mountains in Georgia is confined to a relatively small area, the greater part occurring within Rabun, Towns, Union and Fannin counties, and in parts of Habersham, White, Lumpkin, Dawson and Gilmer counties. Much of the area in mountain forests is above an elevation of 2,000 feet, where the topography is generally rough, with no extensive level areas or plateaus. The mountain land lying above 2,000 feet is classified according to elevation as shown in Table 1.

TABLE 1.

Area and distribution of mountain lands by elevation.

Elevation	Acres	Per cent of area over 2,000 feet
2000-2500	352,705	56.40
2500-3000	177,013	28.31
3000-3500	79,540	12.72
3500-4000	13,367	2.14
4000-4500	2,640	0.42
4500-5000	87	0.01
Totals—	625,352	100.00

Agriculture in the Mountain Region

For the greater part, farming activities in the mountain region are confined to valleys below an elevation of 2,000 feet. In the

past there has been an attempt to farm much land not suited to agricultural crops. This has resulted in abandonment of land with a tendency to retain only the most suitable areas in farms. Table 2 shows the rate at which this abandonment of farms has been going on in three of the most typical mountain counties.

TABLE 2.

Abandonment of farm land in Georgia Mountains. Based on reports by United States Bureau of Census.

Year	COUNTIES			
	Rabun	Towns	Union	Totals
Number of Farms				
1900	1,067	665	1,444	3,176
1910	856	658	1,286	2,800
1920	745	696	1,170	2,610
1925	651	660	1,231	2,542
Acreage of improved land in farms				
1900	30,351	24,385	41,151	95,887
1910	24,048	19,372	44,283	87,703
1920	19,514	22,750	35,722	77,986
1925	14,273	20,728	34,615	69,616

From the above table it appears that 26,271 acres of improved land on 634 farms were abandoned in the three counties between 1900 and 1925. This means that in the 25-year period, 4.5 per cent of the total land area reverted to old fields. The size of the average farm decreased from 141 acres in 1900 to 88 acres in 1925. All these facts point to a growing recognition that certain lands are not suited for farms. There will probably come a time when this land abandonment will cease; when a degree of stabilization will have been reached and only the most suitable land will be retained in farms. However, this remaining desirable farm land within the mountain region is becoming more important each year, particularly for its use in special crops that because of their late season maturity in the mountains can find ready markets in the lower south where similar crops have been harvested earlier in the year. This fact has been recognized by the agricultural interests of the state and

PLATE 1.—Georgia Highlands are the headwaters of many streams important for hydroelectric power. Typical mountain landscape seen from the Neel Gap in Vogel State Park.—*Photographed by U. S. Forest Service.*

has resulted in the establishment in 1930 of the Georgia Mountain Experiment Station near Blairsville, in Union county. This station has already made a significant start toward carrying out studies that will assist in the betterment of both the agriculture and forestry of the region.

Most of the mountain region will no doubt serve the best interests of the state if it remains in timber, not only for the income from wood products but also as a means of controlling the flow of streams which have their headwaters in the mountains, and for developing its recreational possibilities. According to reports of the United States census report 1920, approximately 84 per cent of the land area of the counties of Rabun, Towns and Union is forest land.

IMPORTANCE OF FORESTS FOR WATERSHED PROTECTION

The southern extremities of the Blue Ridge which include the mountains of northern Georgia are known to have the highest annual rainfall in the eastern United States. For the past 27 years the yearly precipitation has averaged about 70 inches at the weather station located in Clayton, Rabun county. This may be considered an average for the mountain region as a

PLATE 2.—Valley farm in Georgia Highlands. Such land is assuming importance for crops that can be produced late in the season for southern markets.—*Photographed by U. S. Forest Service.*

whole. During this period of 27 years, there have been four years when the total rainfall was above 80 inches. During one of these years of exceptionally high precipitation, 1906, the total annual rainfall was about 92 inches. It is in such times that great damage is done by the uncontrolled run-off of rainwater on mountain slopes unprotected by vegetation.

The damage done by floods resulting from heavy rains takes many forms. The soil is removed from unprotected mountain slopes which adds to the difficulty of re-establishing desirable plant growth. Fields in the lower country adjacent to the mountains are sometimes washed away, while others are covered with a layer of gravel and rendered unfit for farming. The finer particles of soil are carried long distances and finally deposited in the quiet waters of power dams, thus reducing their capacity for holding water. The quantity of soil carried by the waters actually adds to the volume of the flood. This heightens flood crests and increases property damage.

Limited information is available as to the part which forests play in reducing the soil carried by flood waters. Examinations made in 1928 by the Appalachian Forest Experiment Station in-

dicate that streams draining the watersheds which have been deforested until less than fifteen per cent of the original forest remained, carried in time of flood, one thousand times more suspended matter than did streams whose watersheds remained in forests.

Adjoining the mountain region of Georgia is an area in southern Tennessee where fumes from the smelters have destroyed the forest and other vegetation. This region is now one of almost hopeless devastation. The streams here are practically dry except for a few hours after rains when they become swollen torrents, carrying a heavy load of soil which has been eroded from the unprotected land. The beneficial influence a forest cover exerts in controlling the flow and condition of the streams cannot be overlooked as one of the most important values of the mountain forests.

One reason for this control of stream flow exerted by forests is the absorptive capacity of the forest litter, or the layer of leaves and twigs which collects on the ground under the forest. This layer is usually in all stages of decay and serves as a sponge which not only soaks up considerable moisture but also protects the soil from the beating effects of wind driven rain, which plays a large part in starting erosion.

Forest litter will absorb a considerable amount of rainfall thus preventing its rapid run-off, but the greatest effect of the litter is in keeping the soil itself absorptive through favoring the development of a loose, spongy texture within the soil. The protection resulting from the litter covering the forest floor is one of the important reasons for keeping forest fires out of the mountain region.

RECREATION IN NORTHERN GEORGIA

Although watershed protection and timber production are usually considered the primary benefits to be derived from the mountain forests, there are other possibilities of drawing an income from this forested area. The mountains of northern Georgia occupy a strategic position from a recreational standpoint. They offer the nearest, most healthful summer playground to the population of the more southern regions. It is the picturesque background furnished by the mountain forests that

makes the region attractive to tourists and vacationists. The development of state forest parks and national forests from the view point of the tourist will do much toward making the region popular. According to a recent report to the United States Senate[1] there were 343,842 hunters and fishermen in Georgia in 1930. The total number of football and baseball fans, golf players and tennis players was found to be but 428,085, or 84,243 more than the number of hunters and fishermen. Proper game management, with particular reference to increasing the number of deer, turkey, grouse and game fish will do much toward attracting a constantly increasing number of sportsmen into the mountain forests.

Although important, the use of the mountain forests as a Mecca for sportsmen is only one phase of their recreational value. The completion and improvement of highways has brought, and in the future, will bring many people to the mountains largely for the enjoyment of the picturesque and scenic values of the Blue Ridge country. During 9 months in 1928, approximately 10,100 people signed the register at Neel Gap in the Vogel Forest-Park. In 1930, during a similar period, 12,590 names were registered at Neel Gap. This increase of over 2,500 visitors took place in spite of the tendency for a smaller percentage of these visitors to register as the holiday crowds at the park increased.

The esthetic values of the mountains and their forest cover cannot be overestimated as an attractive and healthful recreation ground for visitors. Forest fires would destroy the greater part of these attractions.

A start in game management was made with the establishment of the Federal Game Preserve in southern Fannin county. This preserve lies entirely within the Cherokee National Forest and is about nine miles long in an east and west direction and eight miles from north to south. Other game refuges, both state and federal, will be necessary if ample breeding grounds are to be provided for the satisfactory restocking of the mountain forests. Much information not now available will be needed to

[1]United State Senate Report 1329, 71st Congress, 3rd Session. Report from the Special Committee on Conservation of Wild Life Resources. January 21, 1931.

PLATE 3.—Fine 25 year old stand of oaks on abandoned field, that should be thinned and protected from fire. Such stands offer excellent cover for game.—*Photographed by U. S. Forest Service.*

efficiently restock the region with game. In addition, an intelligent educational and law enforcement program must be carried out. The potential value of a large game crop should be brought to the attention of the local populace and their cooperation solicited in its protection and proper use.

It is an obvious fact, and generally understood in northern Georgia that forest fires, if uncontrolled, can greatly reduce if not completely destroy possibilities of restocking the region with game. The United States Forest Service, the Georgia Forest Service, and lumber companies are all working on the problem, with the result that the annual fire toll of game is being steadily reduced. The entire populace of the region must consider itself

a part of the fire protection organization if restocking the mountain region to game is to be successful.

While it is not true that forests depend upon game for their existence, it is true that game should be more widely considered as a product of forested areas.

FOREST PRODUCTION IN THE HIGHLANDS

Composition of the Forest—So far as variety and number of plant species are concerned, the flora of the Georgia highland is one of the richest in the entire continent. No less than one hundred and forty species of forest trees alone occur within the region. Approximately one-half of these trees have some commercial significance. Of the commercial trees only seven species are coniferous, the remainder being broadleaf or hardwood species.

The mountain forest is made up of many combinations and mixtures of tree species which is determined largely by the nature of the particular area that is being considered. From a survey of over 33,000 acres made in Union and Towns counties it was found that the areas of mountain forest would be classified briefly as in Table 3:

TABLE 3.

Subdivision of forest areas by classes.

Class	Per cent of total area
Cove and stream bottom	3.0
Lower and middle slope	41.4
Upper slope and ridge	42.9
Timbered old fields	11.0
Open areas	1.7

From these figures it is possible to obtain a broad understanding of certain forest conditions. For instance, it is generally known that timber production is high in coves. Here conditions of soil and moisture are such that rapid growth can take place. From Table 3 it is apparent that the coves and stream bottoms along with the old fields comprise 14 per cent of the forest area. This proportion then is the area of most rapid growth. Lower and middle slopes come next in order of production, while upper slopes and ridges give the poorest growth.

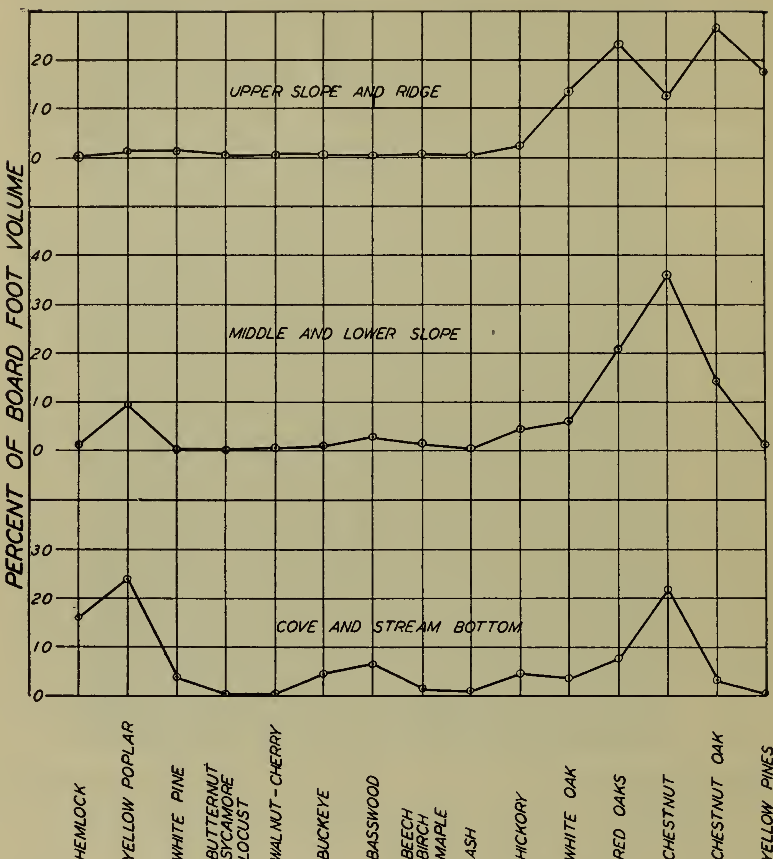

CHART 1.—Forest composition based on commercial timber estimates of 29,194 acres in Union and Towns Coutnies.

The distribution of the various timber species on each of these divisions of the forest area is shown in Table 4 and graphically in Chart 1.

Table 4.—General forest composition.

Species	Per cent of total board foot volume in each type			
	Stream and Cove	Middle and lower slope	Upper slope Ridge & cove	Old field
Hemlock	16.3	1.4	0.3	0.5
Yellow poplar	24.0	9.6	1.2	53.6
White pine	3.7	0.3	1.3	0.4
Butternut-sycamore locust	0.1	0.1	0.1	1.2
Walnut & cherry	0.3	0.4	0.1	0.4
Buckeye	4.6	1.0	0.1	0.1
Basswood	6.4	2.6	0.2	0.2
Beech-birch maple	1.4	1.3	0.8	0.2
Ash	1.0	0.4	0.1	0.1
Hickories	4.7	4.5	2.4	1.9
White oak	3.7	6.0	13.6	6.7
*Red oaks	8.0	20.8	23.1	13.6
Chestnut	22.0	36.0	12.5	17.9
Chestnut oak	3.6	14.2	26.7	0.8
§Yellow pines	0.2	1.4	17.5	2.4

*Includes black, scarlet, and southern red oaks.
§Includes shortleaf, pitch and Virginia pines.

From these figures it is obvious that 24 per cent or nearly one-fourth of the total board foot volume in coves and stream bottoms is yellow poplar. This species, with hemlock and chestnut, contains 62 per cent of all merchantable timber on such areas. Other valuable species such as white pine, buckeye, and basswood are found most frequently in coves, although taken together they furnish only about 15 per cent of the merchantable timber in the cove and stream bottom type.

On middle and lower slopes chestnut furnishes the greatest amount of merchantable timber of any one species. It is followed in order of importance by the red oaks, chestnut oak and yellow poplar. Together, these species contain 81 per cent of all merchantable timber in the type. Such species as walnut,

cherry, beech, birch, maple, and the hickories appear to have about the same representation on middle and lower slopes that they have in the cove and stream bottom type.

Chestnut oak is the leading species on the ridges and upper slopes. Here it provides slightly over one-fourth of the merchantable standing timber. The red oaks are present in nearly equal amounts. The yellow pines show a sudden increase over their occurrence at lower elevations, being third in order of importance. White oak takes fourth place, contributing approximately 14 per cent of the merchantable saw timber. Chestnut contains only 12.5 per cent of the board feet volume on this site. The oaks and chestnuts, together with yellow pine, comprise 93 per cent of all merchantable timber on ridges and upper slopes.

On old fields it is found that yellow poplar makes up over half of the timber volume. A very important characteristic of this species is its ability to seed old fields and rapidly establish a forest stand.

The direction in which a mountain slope faces also has a great influence upon the forest composition. For instance, on south and west slopes, white, black, scarlet and chestnut oaks are found much more frequently than on north and east slopes of the same elevation. In the first case, they form over three-fourths of the merchantable stand, while on north and east facing localities, less than one-half of the forest stand is made up of these species. Certain trees, such as post oak and southern red oak occur most frequently on dry south and west slopes, thereby indicating their ability to occupy the poorest of sites.

Unfortunately, chestnut occupies a very prominent place in the stand and its unavoidable death by the chestnut blight will remove a rapidly growing and high-grade timber tree from the forest. The figures in Table 4 show the stands as they were before the chestnut blight became wide spread in the Georgia mountains. In the summer of 1930 it was found that an average of 40 per cent of the chestnut trees 4 inches in diameter and larger were blight killed. However, the percentage of dead trees varied considerably with elevation. Apparently the blight is not as severe at higher altitudes. At an elevation of 2,900 feet above sea level 25 per cent of the trees were dead. Between 2,000 and

2,300 feet the mortality due to blight was found to be about 60 per cent.

FOREST GROWTH RATE

Because of the very favorable climatic conditions a high growth rate might be expected in the mountain forests. During a field study of two months' duration the most rapid growth discovered was made by a stand of yellow poplar (see plate 4) in the Sosebee cove near Wolf Pen Gap, Union county. Conditions in this cove are excellent for the growth of yellow poplar.

PLATE 4.—Exceptionally fast growing stand of yellow poplar in Sosebee Cove, Union county, Georgia. The timber is 55 years of age.—*Photographed by U. S. Forest Service.*

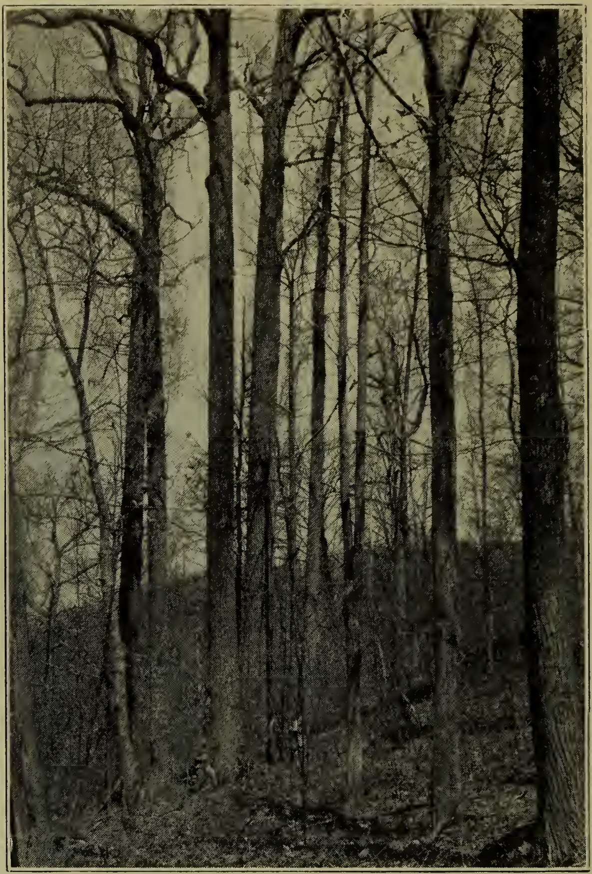

PLATE 5.—Virgin yellow poplar in Georgia Highlands.—*Photo by U. S. Forest Service.*

A half acre in one of the best stocked portions of this stand was measured in 1923 when the timber was 48 years of age. At that time it contained 15,646 board feet of lumber in trees 12 inches and larger at breast height. This stand was again measured in 1930 and found to contain 17,946 board feet in trees with a diameter of 12 inches and larger. The difference in volume of 2,300 board feet was grown on the half-acre in 7 years or at the rate of 328 feet per year. Provided good forestry practice could produce a large area with as good stocking as existed on this half-acre, the yearly growth would have averaged

656 board feet per acre for the 7 years between 1923 and 1930. However, such growth is unusual and will occur only on limited areas.

Growth Rate of Different Species.

No doubt on suitable sites yellow poplar is the fastest growing hardwood found in northern Georgia. For instance, Chart 2, which is based on the best available data, shows that at 50 years of age yellow poplar has an average breast high diameter of nearly 13 inches; while scarlet oak, its nearest competitor among the hardwoods, has reached a diameter of only about 8 inches.

Chart 2 shows the average diameter growth by species of all classes of trees except those which are badly decayed. No data were obtained for chestnut, since it probably will not play a large part in the forest stands of the immediate future.

From Chart 2 it is apparent that scarlet and black oak grow more rapidly than any of the other oaks except in early life. Southern red oak has a rapid early growth but is soon surpassed by scarlet and black until at 100 years of age it has a diameter about equal to that of white oak. Post oak, of course, is the slowest grower.

In old fields, shortleaf pine also grows very rapidly. Its growth on these sites, as shown in Chart 2, is slightly greater than that of yellow poplar.

Volume Production on Cut-Over Mountain Slopes

The figures in Table 5 show the average number of trees per acre that were found on cut over forested slopes of average stocking between the elevations of 2,000 and 2,500 feet. Nearly 60 per cent of the land area above 2,000 feet lies between these elevations and is therefore of particular importance from the standpoint of forest growth. By measuring the growth rings of wood cores taken from the standing trees an estimate was made of the wood production for the past 20 years. These growth figures are presented in Table 6.

Data in Table 5 and Table 6 are based on 16 half acre sample plots representing typical conditions.

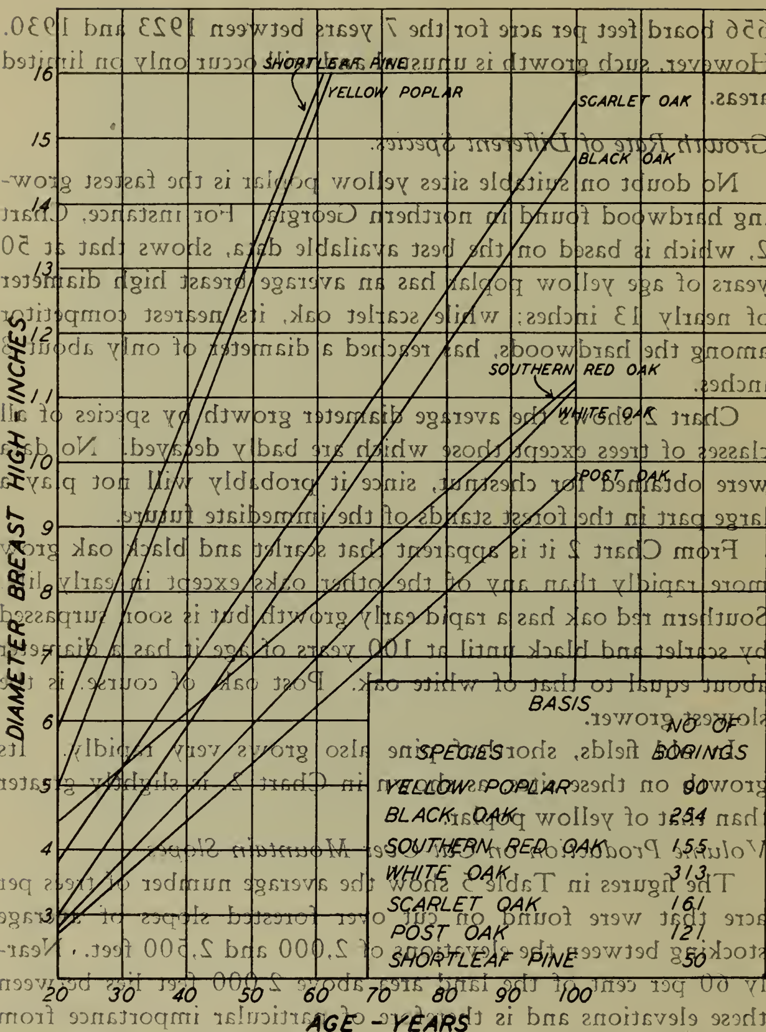

CHART 2.—Rate of growth shown by comparative diameters of mountain hardwood of north Georgia.

Table 5.—Average number of trees per acre. Slopes of average stocking. Elevations 2,000 to 2,500 feet.

D. B. H. Class Inches	White Oak	Black Oak	Scarlet Oak	Chestnut Oak	Southern red oak	All other species	Totals
5	6.7	3.6	1.4	3.6	2.1	7.7	25.1
6	6.7	7.9	2.6	2.8	1.8	4.6	26.4
7	8.1	5.6	2.0	2.0	1.3	3.3	22.3
8	5.0	5.1	3.3	2.7	2.0	3.4	21.5
9	2.5	3.1	2.0	2.0	0.9	1.1	11.6
10	3.2	2.2	0.8	2.1	0.8	1.0	10.1
11	1.9	1.7	1.5	1.1	0.4	0.5	7.1
12	2.1	2.0	0.3	0.7	0.3	0.2	5.6
13	0.4	1.6	0.7	0.8		2.4	5.9
14	0.5	1.2	0.4	0.5		1.1	3.7
15	0.1	0.3	0.7	0.4	0.1	0.5	2.1
16	0.1	0.3	0.4	0.1		0.1	1.0
17		0.5	0.7	0.3		0.1	1.6
18	0.3	0					0.3
19	0.1	0.1		0.1			0.3
20	0.1						0.1
23						0.2	0.2
24			0.1	0.1			0.2
25		0.1					0.1
26		0.1					0.1
27							
28				0.1			0.1
Totals	37.8	35.4	16.9	19.4	9.7	26.2	145.4
Trees 12 inches d.b.h. and over							
	3.7	6.2	3.3	3.1	0.4	4.6	21.3

Table 6.—Average yearly growth per acre 1910-1930. Slopes of average stocking, 2,000-2,500 feet elevation.

Species	Board feet by International log rule ¼" saw kerf.	Merchantable cubic feet
All species	89	42
Major species*	73	37

*White oak, black oak, scarlet oak, chestnut oak, and southern red oak.

Board foot volumes include those trees which were 12 inches in diameter and larger in 1910 and also those which reached this size between 1910 and 1930. Merchantable cubic foot volumes include trees which were four inches in diameter in 1910 and in addition those which reached this size between 1910 and 1930.

PLATE 6.—A 40-year old stand of shortleaf pine, growing on soil once cultivated. Such second growth pine is capable of growing over one cord of pulp wood to the acre each year. —*Photographed by U. S. Forest Service.*

These growth figures give an indication of the present wood production which is taking place on a widespread type of moun-

tain forest. Without doubt the potential wood-producing capacity of these forests is much greater than that indicated by the growth figures. Past cuttings followed by fires have so far reduced the number of desirable trees per acre that production is much less than it would be if the land were fully stocked.

Growth of virgin forests.

Foresters and lumbermen know that as a tree approaches old age its rate of growth becomes slower. This is shown by an investigation of the volume production in the remaining virgin forests of northern Georgia as compared with the growth on well-stocked cut-over slopes. The latter has already been discussed.

According to the best information available the average acre of forested mountain slope previously described produced 1,780 board feet in the 20 years between 1910 and 1930. As shown in Table 6 this amounts to a yearly growth of 89 board feet per acre. The stands upon which these figures are based contained an average of 985 board feet to the acre in 1910. The yearly growth rate during the 20-year period averaged 9.0 per cent.

Examinations of the virgin forests showed that in the same period growth had amounted to 1632 board feet per acre or about 81 board feet annually for all species. As nearly as can be determined these virgin stands contained an average of 3,314 board feet per acre in 1910. Using this figure as a basis the annual growth rate for the virgin forests has been only 2.5 per cent for the past 20 years. This indicates that these old growth stands have passed the period of highest annual volume production.

In general it cannot be said that present forest growth is rapid either in the virgin forests or on cut over areas. This is largely due to over-maturity in the case of virgin forests and to past treatment as already indicated in the case of cut-over areas.

Wood Production on Old Fields.

Old field forests are usually well stocked and they frequently produce merchantable crops of wood in a comparatively short time.

The rapid growth made by shortleaf pine on old fields has already been mentioned. Plate 6 illustrates a stand of this

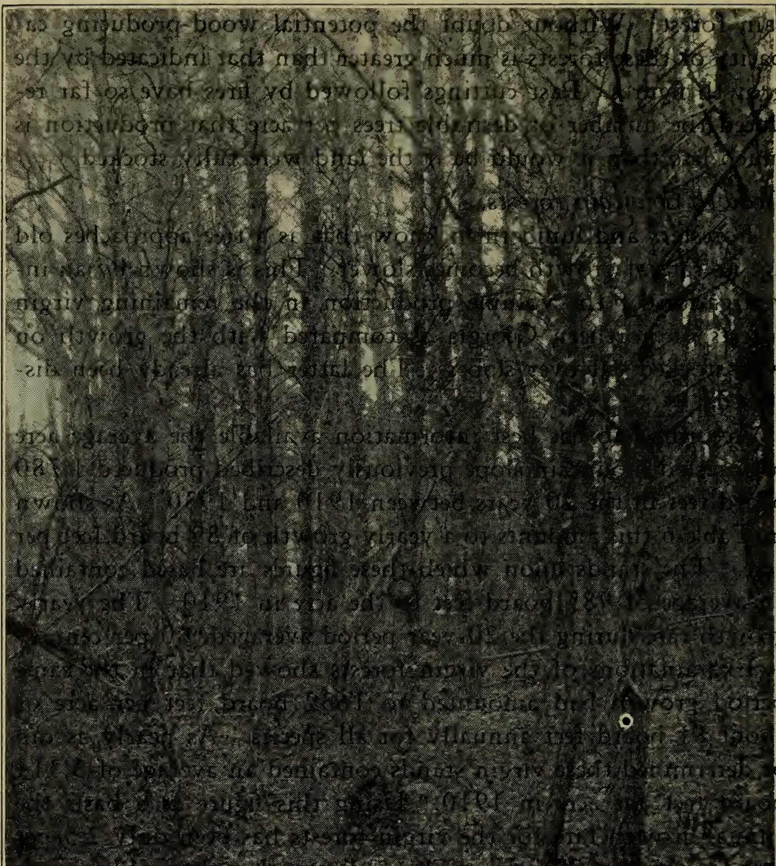

PLATE 7.—Old field stand of Virginia pine 43 years of age. This tree may be used for pulpwood.—*Photographed by U. S. Forest Service.*

character located in Union county at an elevation of approximately 2,000 feet. The age of this stand was found to be 40 years and the growing conditions average for shortleaf pine. The following tabulation shows for the stand the volume per acre by 10-year intervals, the average yearly growth for the past 20 years and also for the entire life of the stand.

Growth of Old Field Shortleaf Pine

Product	Volume per acre by decades			Average annual growth per acre	
	1910	1920	1930	1910-1930	Entire life of stand
Cords—Peeled wood	15.7	28.2	45.7	1.5	1.14
Board feet	1836	3656	5504	183	138

NOTE: Cordwood volumes include all trees five inches in diameter at breast height and larger. Board foot volumes include all trees 12 inches in diameter at breast height and larger. This table is based on increment cores from 50 trees.

From the above table it is obvious that the merchantable growth of the pine for the last twenty years has been somewhat faster than the average growth for the entire life of the stand. This is largely because the growth during the period 1910-30 has been concentrated on trees of merchantable size, while growth during early life was made by trees too small for pulpwood, many of which have died through suppression by faster growing trees.

The rate of growth on an old field stand of poplar 36 years of age was studied for comparison with shortleaf pine. The site was slightly above average for poplar and the yield was found to be 31 cords per acre of wood exclusive of bark in trees of the five-inch diameter class and larger. There were 4,000 board feet of lumber per acre in trees 12 inches in diameter at breast height and larger. This represents an average annual growth for the entire life of the stand of about 0.86 cord of peeled wood, or 112 board feet of saw-timber.

Compare the yields made by these pine and poplar stands with the production of a well stocked old field of mixed hardwoods located at a similar elevation. The site, or the conditions for growth, was found to be about average for Appalachian hardwoods and the age of the stand was approximately the same as that of the pine and poplar. The average yearly growth of this stand for its entire life was found to be one-half cord of rough wood (with bark) to the acre, or a little less than one-half the growth made by the pine stand.

This comparison illustrates one of the fundamental differences that exist between the growth of pine and hardwood stands. Where both types of forest are growing under average favorable conditions for their particular requirements, the pine will produce a larger wood crop at an earlier age than will the mixed hardwoods. Since there is a considerable demand for pine as pulpwood, this rapid growth makes it a particularly desirable species for old fields at the lower altitudes. For saw-timber production, shortleaf pine is to be preferred to any of the other native pines such as pitch or scrub (Virginia) pine. Although for the first 30 or 40 years these grow at about the same rate as shortleaf pine, they do not sustain rapid growth into saw-timber sizes. Scrub or Virginia pine has a tendency to hold its dead limbs on the trunk, thus producing knots and low-grade lumber. A stand of this species is shown in plate 7. Compare this picture with the shortleaf pine of about the same age shown in Plate 6.

However, Virginia pine has exhibited an unusual ability to seed in and reforest abandoned fields at the lower elevations. In this respect it has surpassed all other pines. There is evidence to support the opinion that the area occupied by this species is increasing. Due to its rapid early growth and wide use as pulpwood, this species may be expected to furnish an appreciable percentage of the income from forested areas immediately adjacent to the cultivated lands of the lower valleys.

Old fields located in high, moist coves are ideal sites for yellow poplar. The rapid growth made by this species has already been mentioned and it should be favored above all others in cove sites, whether old field or not.

Saw-timber production in the more mature hardwood stands found in old fields is occasionally very high. The growing conditions are about average for Appalachian hardwoods. The majority of the trees are black oak, which is one of the fastest growing of the hardwood species. In 1930 an 80-year-old stand contained an average of 38 trees per acre of 12 inches breast high diameter and larger. These contained an average of 333 board feet per tree, or about 12,650 board feet to the acre. Since the stand is 80 years of age, the yearly growth has averaged 158 board feet to the acre.

Summary of forest growth.

On the basis of such observations as have been described, it is estimated that the average yearly growth of all species on cut-over mountain slopes is about 89 board feet per acre, as compared with 81 board feet for virgin stands. The annual production of peeled wood in well-stocked old field stands of shortleaf pine averages slightly over one cord per acre, while well-stocked stands of poplar produce slightly under one cord of peeled wood per acre.

Mixed hardwoods growing in old fields produce annually an average of about one-half cord of wood per acre for stands under saw-log size. Older stands of hardwood may grow about 158 board feet to the acre each year.

Time required to grow special products.

From Chart 2 it is possible to estimate the average length of time required by the various species to grow trees of proper sizes for special products such as pulpwood, posts, ties and poles. This has been done in Table 7. It should be clearly understood that the various periods required to reach certain specified sizes are averages and are based on all the fairly sound trees examined in the woods. A small proportion of the trees in each stand will reach the specified size 10 to 15 years sooner than the majority. Likewise a certain proportion will take longer to reach the desired size than is shown in Table 7.

Table 7.—Average number of years required to grow special products.

PRODUCT	Diameter of tree Breast High Inches	Number of years by species						
		Shortleaf pine*	Yellow poplar	Scarlet oak	Black oak	So. Red oak	White oak	Post oak
Pulpwood	5	17	20					
Fence posts	7			42	48	51	60	69
Ties and poles	11	41		69	75	97	99	100+
Sawlogs	12	45	47	76	81	100+	100+	100+

*Old field.

However, from this table a growth comparison of the various species is possible. For instance, shortleaf pine and yellow poplar produce sawlogs 30 years earlier than scarlet oak, which is the fastest growing oak in the mountain forests. It requires about five years longer for black oak to reach sawlog size than scarlet oak. Southern red oak, white oak, and post oak take, on the average, over 100 years to produce a sawlog tree 12 inches in diameter at breast height. Post oak rarely reaches a size suitable for saw-timber.

Scarlet oak and black oak reach a size suitable for cross ties and poles at an age of 70-75 years. Southern red and white oak require nearly 100 years to reach the same diameter, while post oak commonly takes over 100 years to produce trees of pole or tie size.

TREATMENT OF FORESTS

In formulating a proper system of management for mountain forests the first consideration is to determine how these forests can best serve the interests of the state. However, no matter what the particular use in mind—watershed protection, recreation and game management or the production of wood products—certainly a well stocked rapidly growing forest is the first essential. Such a forest cannot be maintained without adequate fire protection. This protection will be assured when each individual citizen of the state recognizes the significance which the forests have upon his personal affairs and well being, and when he is willing to exert every possible effort to reduce forest fires to a minimum.

As has already been pointed out in this bulletin much of the forested land in the Georgia highland is not well stocked and for many reasons is not producing the amount of forest products of which it is capable. In a number of ways the forest land owner may improve the stocking and vigor of his timber lands.

Immediate harvest of chestnut advisable

One of the outstanding immediate problems of the mountain forests deals with the harvesting of chestnut. No doubt this valuable tree is doomed by the chestnut blight. Because this disease started in New York and spread south over the range of

chestnut, the mountain forests of Georgia were among the last to be infected.

In 1930 approximately half of the chestnut stand was still alive. Mere killing by the blight does not mean that the dead trees are useless. The disease itself does not weaken or destroy the wood in any way[4]. However, when the tree is nearly dead, wood decaying fungi become established in the blight killed portions of the sapwood. After about two years rot becomes well established in the sapwood and this decay is spread by the burrowing insects. Within four or five years after the death of the tree, the sapwood and bark is almost completely rotted away. During this time a certain amount of checking has been going on which often renders the tree undesirable for anything but acid or fuelwood. The boring of timber worms also reduces the quality of lumber which can be sawed from blight killed trees.

It has been shown in Table 4 that from 12 to 36 per cent of board foot volume of the mountain forest stands is chestnut. Unless cut immediately much of the value represented by this species will be lost.

Whenever possible, suitable living trees and those not badly damaged by rot or insects should be cut for lumber. Poles, piling, ties, mine props and posts can be obtained from a chestnut stand not too long dead. Cordwood for the tannin extract and pulp industries can be cut from trees which have been dead for 20 years. However, the work of utmost importance is the immediate harvest of all living and recently dead trees for the higher quality material which can be obtained from them.

Cordwood cuttings an aid to forest improvement.

In many cases an area of natural woodland can be made more productive by cutting undesirable species and poorly formed or slow-growing trees of desirable species. By removing poor trees better individuals are favored and allowed to reach their full development with less competition. This results in more rapid growth of the best timber and therefore a reduction in the time required to reach merchantable size.

A test of such an operation by means of a fuelwood cutting

[4]Circular 370, U. S. D. A. Chestnut Blight in the Southern Appalachians, by G. F. Gravatt and R. P. Marshall.

was made by the Appalachian Forest Experiment Station in the fall of 1930, on the timber tract of the Georgia Mountain Experiment Station. A half acre plot was established in a stand consisting for the most part of white, southern red, scarlet and black oak. In mixture with these more valuable species was

PLATE 8.—Fuelwood cuttings should remove defective and diseased trees leaving a well spaced stand of desirable species. Georgia Mountain Experiment Station.—*Photographed by the U. S. Forest Service.*

found post oak, black gum, sourwood and several other inferior varieties. The ages of the trees in this stand varied from 40 to 120 years.

The cutting removed crooked and decayed trees and also such species as sourwood, black gum, and post oak. Fairly good trees which were crowding the best trees in the stand were also removed. In this particular case it was considered advisable to favor southern red, white, and scarlet oak since the largest and most rapidly growing trees on the area consisted of these species.

The stand before thinning contained 330 trees per acre, ranging from 2 to 14 inches in breast high diameter. The cutting removed 196 trees per acre, leaving 134 of the best trees. The general character of the remaining stand is shown in Plate 8.

The cutting yielded 22 cords of 2 foot wood per acre at a cost of $1.48 per cord. After paying 50 cents a cord for hauling three and one-half miles to the nearest market, the improvement

cutting would pay for itself at the customary price of $2 a cord. Looking at this example in a different way and allowing nothing for stumpage or taxes, the cutting paid wages at the rate of $1.48 a cord, after charges for hauling to market were deducted.

Although the profits from this operation are negligible it must be remembered that a stand of 130 trees per acre of the most desirable species still remains. These trees need no longer compete with their inferior neighbors for light, moisture and plant food. There is every reason to expect that they will now reach tie, pole, or sawlog size much sooner than if the improvement cutting had not been made. Just what this difference in time actually is will be determined by future measurements of the stand in comparison with a similar nearby area which was measured but not thinned.

When making cordwood cuttings in the mixed hardwood forest, landowners should consider the possibilities of improving the stand that it may give the greatest possible returns in the future.

Thinnings for pulpwood in old field stands of pine and yellow poplar.

It has already been pointed out that pine and yellow poplar grow very rapidly, particularly on old fields. Under average growing conditions and where the land is fully stocked with trees, pulpwood thinnings can be made between 25 and 30 years of age.

Past experience has shown that in thinning pines the best results are obtained by cutting from 45 to 50 per cent of the total number of trees. The cutting should remove all trees which are completely overtopped and also those which are hindering the growth of the best individuals. In stands of these ages the remaining trees should be well separated, that is, there should be at least 2 to 3 feet of space between their crowns to provide enough room for unhindered future growth. Such cuttings coming between 25 and 30 years of age will yield from 5 to 12 cords of four-foot pulpwood to the acre, depending largely on the degree of stocking. The remaining trees are free to grow unhindered and will reach sawlog size much faster than would be the case if left to grow under natural conditions. Such a cutting will allow a second thinning 10 to 15 years later.

The above applies to old field pine particularly. Very little is known regarding the best methods of thinning yellow poplar. In general, stands of this species are not so dense as those of pine and if equal degrees of thinning are practiced the yield will be somewhat below that of pine. However, the same general rules as suggested for pine should be followed in thinning poplar.

In 1929 a better than average stand of yellow poplar 41 years old was thinned at Cranberry, N. C.[6] Thirty-one per cent of the trees were cut including all those which were overtopped, or of poor form. The cutting also removed a few good trees which were crowding the best individuals in the stand. This cutting yielded 15 cords per acre in pulpwood and left standing 164 trees to grow for the final crop of sawtimber. A heavier cutting than this would be advisable in stands which are nearing sawlog maturity.

Summary of Thinning Practices.

To summarize, a general thinning plan for well-stocked stands of shortleaf pine and yellow poplar may be outlined as follows:

1. First thinning to be made at 25 to 30 years of age. The cut should remove 45 to 50 per cent of the trees.
2. Second thinning to be made at 40 to 45 years of age when all trees should be cut except 125 to 150 trees per acre. These remaining trees should be chosen for their good form and high quality. Being freed from competition with poorer trees they will approach sawtimber size rapidly and form the final crop.

Relative merits of tree species.

The decision as to which species should be favored in making improvement cuttings will depend largely on the particular stand under consideration. In many cases the most desirable species may make up only a small part of the stand, so that it is necessary to weigh carefully the relative merits of the species making up the remainder or the stand, in deciding which trees to remove. In mixed oak stands between the elevations of 1800 and 2800 feet, white oak, southern red oak, and black oak have

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[6]Plots established by Appalachian Forest Experiment Station.

shown themselves to be more valuable for the production of forest products than have scarlet oak or post oak. Northern red oak, where it occurs, is a valuable species and should be given every opportunity to establish itself. This species favors high north coves where it exhibits an unusual ability to prolong a rapid growth to great ages.

On rich, moist soils black cherry, black walnut, cucumber magnolia and white ash are species with a relatively high commercial value. Black cherry particularly has shown itself to be a vigorous and rapid growing tree in the Georgia mountains and will probably always be valued for high grade furniture wood. Basswood may also be considered a valuable species where it occurs.

Unquestionably on soils favorable for its growth, yellow poplar has the highest general rating of any tree in the mountain region. The tree is valuable for pulpwood and poplar sawlogs are much in demand. The species is a vigorous grower, has few enemies and is relatively free from defects.

Black locust is a rapid grower and makes a desirable tree when the saplings are not completely destroyed by the locust borer. Black locust is of high value for posts and small poles because of the durability of its wood in contact with the soil. It is an easy tree to propagate and is becoming important for planting on wornout lands, to prevent further depletion of the soil through erosion.

Chestnut has probably lost its importance as a valuable tree in the mountain forest because of the increasing prevalence of the blight. Shagbark, mockernut and pignut hickories have a potential value on moist, fertile soils. On poorer sites these species grow slowly and are of doubtful durability.

Of the dry site oaks, chestnut oak is the most desirable. It bears abundant seed and reproduces itself under relatively unfavorable conditions. The tree is useful for saw-logs, for railroad ties and for tanbark.

As already pointed out, yellow pines, and particularly Virginia pine, are important from a pulpwood standpoint. This species is rapidly taking over abandoned fields many of which remain in the possession of small landowners. In many ways

the handling of stands of Virginia pine is becoming a farm woodland problem.

White pine is seeding in under the hardwood stands on lower slopes adjacent to many mountain streams. This is true particularly on areas which have had the advantage of many years of protection from fires. Due to its greater tolerance of shade and other inherent characteristics, white pine has a greater ability than any other native pine to seed in and become established under a hardwood overstory. Increment borings made in white pine seed trees when compared with borings made in hardwood trees of the same size occurring on the same area, show that this pine has a much greater growth than any of its associates with the possible exception of the yellow poplar. In all cases where it occurs, the young growth of white pine under a hardwood stand should be favored by removing or deadening the poorest of the hardwood overstory.

A number of small tree species common to mountain forests have no particular commercial value at present. These are sourwood, silverbell, sassafras, serviceberry and hawthorn. On the other hand, persimmon and dogwood have special usage because of the character of their wood and it is possible that the demand for these two species may increase.

Red maple, buckeye and black gum are increasing in importance for paper pulp. It is difficult to predict to what extent the demand for special wood products will increase. It is quite possible that some species, not now considered of importance, will become of high commercial value for special uses. The present demand for black gum and closely related species, by the southern pulp industry is an example. With increasing changes in the demand for special wood products other little-used species may become important. When the demand becomes large enough these species must be given their proper place in the management of the hardwood stands.

Bulletin 16 NOVEMBER 1931

Georgia Forest Service

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Planting Longleaf and Slash Pines

By

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PROTECTION
CONSERVATION
PERPETUATION
GEORGIA
FOREST SERVICE

INDEX

Planting Longleaf Pine

Planting Slash Pine

Planting Longleaf Pine

By H. M. Sebring

Longleaf pine has a wide range in Georgia and has been a great contributor to the timber wealth of the state. In parts of middle Georgia the name "Longleaf" is applied to the loblolly pine (Pinus taeda). This publication deals with the true longleaf pine (Pinus palustris). Its distinguishing characteristics are dark green needles 8 to 15 inches long held in drooping clusters, large club-shaped growth buds, cones from 6 to 10 inches long, and its ability to yield gum for producing naval stores.

Distribution and Soil Requirements

Longleaf pine is found naturally throughout South Georgia. Its northern boundary is somewhat irregular, but can be approximately located by drawing a line in a southwesterly direction from Augusta to Macon and then northwesterly from Macon as far as Rome. Ability of longleaf pine to grow on the poorest and dryest sites, together with its fire resistance, enables it to have an important part in a reforestation project where full utilization of all sites is desired. With its long tap-root, longleaf is naturally adapted to dry sites, and is *never* found growing where water stands for any length of time. In the flatwoods of south Georgia, it is found on well drained low land, frequently only one or two feet higher than the ponds. It is adapted to all types of soil except rich alluvial river bottoms and wet soils, and is the best commercial timber tree for the dry and deep sandy ridges of middle and south Georgia.

When Planting is Necessary

Usually the cheapest way to get a growth of timber started is to let the land seed naturally. This can be accomplished only by having at least three or four seed trees per acre, and by protecting the land from fire. Artificial planting is necessary under the following conditions:

1. If there are no seed trees left after logging.
2. If the area has been taken over by inferior trees.
3. To get a stand of desired number of trees with proper spacing.
4. When a seed crop will not come for two or three years and a stand is desired immediately.
5. To fill open forest spaces with desired species.
6. If the value of the necessary seed trees to be left after logging exceeds the planting cost.

CHOICE BETWEEN SEEDING AND PLANTING

The artificial establishment of a new crop of trees can be secured by seeding or planting. By seeding is meant sowing the seed ("mast") directly on the area the trees are to be grown. Planting is sowing the seed in beds and then transplanting the one-year-old seedings to the area to be reforested.

Seeding—Direct broadcasting without preparation of the soil has been used with comparatively unfavorable results. Direct seeding is nature's way of re-establishing a stand. This could be accomplished with equal success artificially if as much seed were sown as nature distributes. The cost would, however, be prohibitive since an average of five pounds of seed per acre at a cost of $2.00 or more per pound would be required.

Another method is known as spot seeding. In this case, by plowing furrows or by cultivating spots 18 inches in diameter, the distance between the furrows or the cultivated spots will be determined by the desired spacing. After the ground has been prepared from 8 to 10 seeds may be dropped on each spot or in the soil of the furrow at the desired distance, covered with one-fourth inch of soil and firmed lightly with the foot. Covering each spot with light grass or straw litter will help retain moisture and hide the seed from birds. As longleaf averages, without the wings, 8,000 seed to the pound, it will require from one-half to one pound of seed per acre for spot planting. The cost of seed, labor in plowing or spot soil preparation and sowing

Longleaf Pine Plantation 12 Years Old—(Courtesy U. S. Forest Service)

will amount to $1.50 to $2.50 per acre, varying with the spacing and the ground vegetation.

If weather conditions following planting are favorable for quick germination and rapid growth until the seedlings are past the tender stage, and if damage by mice and birds is not excessive, a good stand can be secured. Seed require abundant moisture to germinate, and for three or four months after germina-

tion conditions are not ideal unless the ground is fairly moist all the time.

It is, therefore, evident that good results from seeding will be exceptional. Seeding is cheaper and the seedlings are generally a little larger at a given age than those that have been transplanted because transplanted seedlings generally take a year to get established after being moved from the nursery to the planting site, but it is apparent that the risk is great. All factors working toward the destruction of seedlings established by direct seeding are beyond our control, whereas in growing and planting seedlings, adverse influences are largely under control and on an average the planting method turns out to be cheaper in establishing a stand of pines.

Planting—When planting longleaf the best results can be obtained by using one-year-old seedlings. During the first three or four years the longleaf pine makes no appreciable height growth but spends its energy developing a deep, heavy tap-root and strong lateral roots. The roots on two or three-year-old seedlings have usually developed to such an extent that the cost of digging and successfully transplanting them is prohibitive.

Sometimes it is possible to find a thick stand of one-year-old plants seeded naturally in the woods or in an old field. Such seedlings can be successfully transplanted provided they are dug up (not pulled up) ; kept in a pail of water and transplanted the same day. If not transplanted the same day they should be "heeled-in" in a moist shady place by digging a V-shaped trench as deep as the length of the taproots, placing the seedlings in the trench, covering the roots with soft, moist earth and firming the soil with the foot. Seedlings can be kept in this manner for several days if the roots are kept moist.

The difficulty in transplanting "wild stock" lies in the finding of one-year-old seedlings. At this age the longleaf pine is almost indiscernible in the thick grass cover common as a natural ground cover on a longleaf site. Seedlings do not begin to show up prominently until they are three or four years old. A one-year-old seedling has only one or two dozen straws, and it is

only by keen observation that it can be distinguished from wire grass.

If a large area is to be planted, home-grown nursery stock can be used. Information on how to collect seed, prepare and take care of nursery beds is discussed under "Planting Slash Pine" in this bulletin. If an area less than 100 acres is to be planted it would be cheaper to purchase the seedlings because raising nursery stock successfully requires that beds be given daily attention.

Most planting is done by purchasing one-year-old longleaf seedlings from the State Tree Nursery at Athens, Georgia. This nursery is operated by the School of Forestry of the State College of Agriculture in co-operation with the Georgia Forest Service, and orders can be placed with the School of Forestry or any office of the Georgia Forest Service. Longleaf seedlings generally sell for $2.50 per thousand, exclusive of transportation charges.

State Tree Nursery at Athens—(Courtesy U. S. Forest Service)

Time to Plant—Longleaf pine can be planted between the 15th of November and the last of February. Fall planting is best suited to South Georgia, because winters are mild and the soil and moisture conditions are conducive to root establishment

before the more active growing season. Where there is danger of hard freezing of the soil with the resulting upheaval, fall planting should not be practiced. Spring planting is therefore better suited to longleaf in Middle Georgia.

Seedlings should never be transplanted after they have begun their spring growth. The plant is then in an active stage and with the least drying, death is likely to occur.

The best percentage of stand will be obtained by planting before or after a rain and during a cloudy period. There will then be less danger of the upper strata of soil drying out. Planting should not be undertaken when there is not enough soil-moisture to enable the soil to be packed tightly around the roots. If the soil is dry when the seedlings arrive they should be "heeled-in" and kept moist until planting conditions are favorable.

Spacing—The spacing of the planted seedlings is an important matter. The product or combination of desired products will determine what spacing to use. Close spacing will stimulate height growth at a sacrifice of diameter growth. It will also cause the more shading and natural pruning of side branches resulting in a longer and cleaner trunk with a minimum amount of taper.

Longleaf has the least tendency to branch of any southern pine and can be given a wider spacing for any given product. Close spacing is necessary to grow poles, piling and quality saw timber, and a spacing of 8 by 8, 7 by 9 or any combination giving approximately 680 trees per acre is recommended.

To produce a maximum amount of naval stores with a lower grade of saw-timber, or cordwood or ties in combination with turpentine, or cordwood only, a wider spacing may be used. The object is to develop large-topped trees attaining a maximum diameter at a sacrifice to height, in a given time. A spacing of 10 by 10 or 9 by 11, giving approximately 435 trees to the acre, is recommended for this class of products.

If turpentine is the only product sought, a much wider spacing can be adopted, in which case a stand of 250 or 300 trees per acre is recommended, representing a spacing of 12 by 12, 13

by 13 or wider. Seedlings planted using one of these spacings will develop into short, large-topped trees and will yield a generous amount of gum. Pruning will undoubtedly be necessary to rid the trees of any lower limbs that would interfere with the naval stores operations.

Preparation of Planting Site

Areas fairly clear of inferior trees and undergrowth will not require cleaning. If there is a stand of blackjack oak or shrubby vegetation dense enough to materially reduce the light and moisture supply of the seedlings, some cleaning will be necessary, but it can be confined to a 3 or 4-foot circle around the spot where each seedling is to be planted.

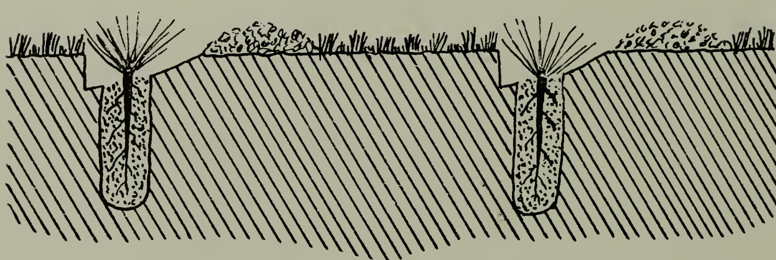
No intensive cultivation is necessary. On areas that are clear of brush it is best to plow shallow furrows not more than 3 inches deep with a light turning plow. The seedlings should be planted in the broken soil. The distance between the seedlings in the rows and the distance between the rows will be determined by the desired spacing. On land that has a tendency to wash, it would be best to run the furrows along the contours. This will also minimize the danger of "silting", which is being discussed later in detail.

On sites containing a large amount of shrubby vegetation, plowing will be difficult and unsatisfactory. It will be best to prepare a planting spot for each seedling by using a grub hoe and removing all vegetation in a circle of approximately 18 inches. If the remaining vegetation is likely to shade-out the seedlings, the site will have to be cleaned as recommended above.

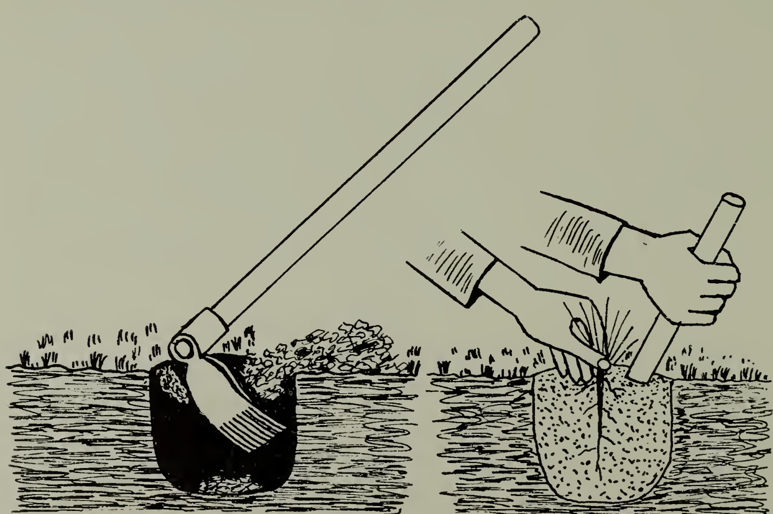
Transplanting Seedlings

The most important precaution to observe when planting is to keep the roots moist at all times. A day's supply of seedlings should be carried to the planting site packed in a tub containing enough muddy water to keep all the roots wet. Each planter should carry his seedlings in a pail containing water, or if a large planting crew is employed, one or two men can be assigned to carry the seedlings in pails, giving each planter a few seedlings

Setting seedlings in holes dug with grub hoe. LEFT—Seedling planted too deep. RIGHT—Seedling set up one-half inch to prevent "silting".



On loose soils shallow furrows should be made with light turning plow. LEFT—Seedling set up one-half inch on slope of furrow to prevent "silting". RIGHT—Seedling planted too deep. Seedlings may be planted on light soils by using "dibble".



Planting method for heavy, tenacious soils or brushy areas where plowing is difficult or unsatisfactory. Use mattock or grub hoe to make hole. Pack soil firmly around roots.

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at a time and remembering that seedlings carried by the planters should never be allowed to dry. Drying causes the death of the fine rootlets and root hairs that are essential for the absorption of moisture and plant food.

Planting can be efficiently executed by working two men to a crew, one making the hole and the other inserting the seedling and firming the soil around the roots. Longleaf pine seedlings should be planted one-half inch farther out of the ground than they grew in the nursery bed. This will minimize the damage from silt washing or blowing in on the terminal bud and killing or weakening the plant. Longleaf will not make any appreciable height growth for at least two years after transplanting, and unless the seedlings are planted one-half inch higher than they were in the seed bed the damage from "silting" in certain types of soil will be heavy.

In fairly loose soil the "dibble" or planting iron is best, although a common spade or trench shovel can be successfully used. When using a dibble to make a hole, the dibble is inserted into the ground a little deeper than the length of the roots, working it backward and forward to get a V-shaped hole large enough to receive the seedling in a position with its roots well spread and not twisted. The soil should first be firmed around the roots at the bottom of the hole. This can be done by inserting the dibble into the ground at a slant (60-degree angle), about 4 inches from the seedlings and bearing down on the handle which has a tendency to close up the bottom of the opening. The planter should then firmly pack the soil around the roots at the top of the hole with his foot.

The importance of firming the soil at the bottom of the hole can not be over-emphasized. Leaving an air space at the bottom will cause partial or complete drying of the roots and result in weak or, more frequently, dead seedlings.

If the soil is hard or tenacious in texture, a dibble will not give satisfactory results because it will be difficult to close the bottom of a V-shaped hole. Under such circumstances, the use of a mattock or grub hoe for digging holes will be best. The hole must be dug deep and wide enough to accommodate all the

roots without crowding or twisting. The planter can push the dirt back with his hand and firm the dirt with a piece of wood or with his foot if the soil is not too heavy.

A crew of two men in a ten-hour day will plant 1,000 to 1,200 seedlings using a mattock or grub hoe, and 1,200 to 1,500 using a dibble.

THREE ESSENTIALS—Three important steps to be diligently taken for success in planting are:

1. Keep roots of seedlings moist at all times.
2. Place roots in their natural position in the hole; firm the ground solidly against roots to their full depth. Tap-roots longer than eight inches can be pruned with a sharp knife.
3. Longleaf seedlings should be planted one-half inch higher out of the hole than they were in the seed bed to prevent damage from "silting".

Silting Prevention—In loose soils, especially on slopes, planted longleaf sometimes suffers from soil being washed or "silted" in among the needles, partly or completely covering the bud. The effect of silting is either a lingering death to the plant or a retarding of height growth. A shallow furrow made with a light turning plow for planting leaves a layer of sod on one side of the furrow to protect the seedling from washing or drifting sand on that side and the furrow provides a trench away from the seedlings, for storing the drift. By plowing along the contours or by cultivating spots 18 inches in diameter around seedlings without plowing, the damage from silting will be minimized. Irrespective of the method used in preparing the planting site, longleaf seedlings should be "set-up" one-half inch higher than they grew in the nursery bed. This will allow space for soil to wash in without affecting the needles and bud.

PLANTING COST

The exact cost of planting an acre of longleaf seedlings can not be given, because the cost varies with the spacing, type of

soil and wage scale. Assuming the cost of seedlings to be $2.50 per thousand and that two men will plant an average of 1,200 seedlings a day, with labor at $1.50 a day, the cost exclusive of preparing the land would be 50 cents per hundred trees. Furrowing will cost from 20 to 40 cents per acre, depending upon the number of trees to be planted. To this must be added the expenses of supervision and hauling material to the planting site. The total cost per acre for planting 680 trees will, therefore, be approximately $4.00; planting 450 trees per acre approximately $2.75; and planting 300 trees per acre approximately $2.00.

Planting sites requiring the cleaning of brush and blackjack oak, or the preparation of planting spots in lieu of furrowing will cost from 50 cents to $1.00 per acre more than the above total figures.

Care of Plantations

Fire, goats and hogs are the three most destructive agencies with which to contend in establishing longleaf plantations. Intensive grazing of cattle before the seedlings have begun height growth may result in trampling and damaging buds of young trees. After the seedlings begin height growth intensive grazing of cattle will be beneficial, as cattle help to reduce the fire hazard by keeping the grass cropped low. Goats eat the terminal and lateral buds and should be excluded from plantations until the trees are six to eight feet high. Hogs greatly relish the succulent bark around the tap and lateral roots of longleaf pine. They kill an inestimable number of two to five-year-old seedlings every year by completely uprooting the plant, or biting off the top and stripping the roots of the succulent bark. Longleaf seems to be the particular seedling that suffers this peculiar fate, and it is very essential that hogs be excluded from plantations.

Longleaf pine is undoubtedly the most fire resistant native tree. Its thick bark and the dense cluster of needles surrounding and protecting the buds enables it to survive many fires. In their early stage the seedlings are most susceptible to fire damage. Where the seedlings are not killed outright by a fire, the burning

of the leaves and scorching of the buds and growing tissues result in a marked retarding of growth.

Protection is essential and can be procured at an annual cost of from 5 to 10 cents an acre by constructing firebreaks to break the plantations into blocks of 50 to 100 acres each. Firebreaks can be constructed either by plowing solid strips 8 to 12 feet wide, or by plowing two furrows 30 to 40 feet apart and burning out the grass between the furrows.

GROWTH AND PROBABLE YIELD

No attempt will be made to give definite growth and yield figures, for these will vary with soil fertility and previous condition of the site. Old fields planted to longleaf will show more rapid growth than natural woodlands, due to absence of competing vegetation and the presence of some fertilizer left in the old field soil.

On a fairly good site with fire protection longleaf at 40 years of age should average 2 feet in height growth a year and produce an average of 1½ cords of wood per acre per year. Trees 9 inches in diameter 4½ feet from the ground suitable for turpentining can be raised in 25 to 30 years from seed. A return from cordwood can be secured in 12 to 15 years, and a stand of sawtimber containing 12,000 to 15,000 board feet per acre can be raised in 40 years. A net return of from $1.00 to $3.00 per acre can be expected from longleaf pine plantations on a 30 to 40-year rotation.

Planting Slash Pine

By JACK THURMOND

Introduction

It is possible to transplant a pine tree successfully, as has been demonstrated by many landowners in South Georgia who have planted millions of seedlings in different sections of the naval stores region of the state. In some of the earlier plantings many mistakes were made and sometimes the results obtained were discouraging, due primarily to insufficient knowledge of planting methods, including time of planting and type of stock to use. This bulletin will deal with the planting of slash pine and is distributed with the idea of aiding many to avoid some of the losses which some of the early planters sustained.

WHERE TO PLANT

In many instances enough seed trees are left after logging operations to naturally reseed the area if fires are kept off of the land, at least three good seed trees per acre being necessary and seven more desirable for satisfactory natural reproduction. It is believed by many timber growers that more economical stocking is obtained by planting because one gets quicker reproduction, better spacing, fuller stands and the most desirable species, thus enabling the owner to obtain a quicker turnover on the money invested.

It is certainly advisable to plant tracts left free of seed trees by loggers, lands rendered unprofitable for agricultural crops by poor farming practices, area which are naturally too poor for farming and lands that have undesirable species on them, such as scrub oak and other inferior trees.

WHAT TO PLANT

When a landowner decides to plant the next question is what to plant. In South Georgia, which is also the turpentine producing section of the state, two pines are the most desirable, slash pine (Pinus caribeae) and longleaf pine (Pinus palustris).

The former is more desirable as it grows faster in its early life, but on sand ridge types of soils, longleaf will give better results due to its greater ability to survive the quick drying-out of the extremely sandy soil of such lands. Where possible, slash pine should be planted as it not only grows faster than under natural seeding but yields more gum per tree, has less scrape and the lumber is practically as good as the longleaf product.

SOIL REQUIREMENTS

Slash pine will grow on practically any soil in its range. Best growth has been attained on sandy loam fairly well drained but it may be found growing on dry soils near the northern limit of its range or in deep, wet bays in the extreme southern part of the state that sometimes remain inundated for several months during the year.

SEEDING METHODS

It is well at this time to discuss broadcasting of pine seed. It will take from four to six pounds of seed to broadcast an acre. Germination will be poor as the seed have no protection from hogs, rodents, birds and other seed consumers. The cost of this type of reforestation is prohibitive, running from $10 to $13 per acre.

Spot seeding is planting seed in each place where a tree is desired. This method is less expensive than broadcasting and gives slightly better results because the seed are a little better protected from hogs, birds and rodents, but as will be shown, other methods give better results.

WILD OR WOODS-GROWN STOCK

A method of getting an area stocked which might appeal to the planter is to go out and lift wild seedlings where they grow most abundantly along creeks and bays, being careful not to disturb their roots any more than is absolutely necessary, but being certain that the seedlings are not less than ten inches or more than eighteen inches in height. In other words, use one-year-old

Lifting Wild or Woods Grown Seedlings

stock. After lifting the seedlings should be put into a tub or bucket which is one-third full of "puddle", made by mixing the soil from which they are taken with enough water to make a soupy mixture. The seedlings should be kept in this puddle from the time they are taken out of the ground until they are planted to the desired site. Be sure to keep the air away from the roots. Seedlings obtained and transplanted in this manner have given as high as 97 per cent stand. Avoid the expensive practice of using older stock which will not survive the shock of transplanting. Use the one or two year old seedlings in all cases.

Nursery-Grown Seedlings

One good method of securing planting stock where a small number is desired is to buy seedlings direct from the State Nursery at Athens, Georgia. This nursery is conducted by the School of Forestry of the State College of Agriculture in co-operation

with the Georgia Forest Service. Seedlings are there grown in seedbeds, have a well developed root system and efforts are made to keep them free from disease. If a planting of over 40,000 is to be made it would be cheaper for the individual to have his own seedbed. The seedlings grown in the State Tree Nursery are sold at cost of about $2.50 per thousand, F. O. B. Athens. This source of planting stock should be considered before a planting is made.

HOME-GROWN SEEDLINGS

In raising planting stock at home, the first thing necessary is to get good seed. These may be secured from a reliable seed house whose address may be secured from the nearest office of the Georgia Forest Service or from the Forest School at the State College of Agriculture in Athens. Seed should be planted within at least five months after gathering and sooner if convenient. Slash pine produces a seed crop every other year and a bumper crop every three to five years. Production, of course, will vary in different localities depending on climatic conditions and moisture content of the soil.

In collecting planting seed the cones of slash pine should be gathered from the 5th of September to the 25th, as they begin to turn brown and open near October 1st. Do not wait until they are open and do not depend upon some logging operation as the best cones are obtainable from medium old trees, while logging operations take only mature and generally over-mature trees, which produce less desirable seed. Cones from younger trees may be obtained at very little cost as two men can gather about 12 to 15 bushels per day from the trees, each tree yielding one pound of dry seed per bushel of cones. One can expect on an average 14,000 seed to one pound. When gathered cones should be stored on a tight floor in a warm, dry place and turned over every three days until thoroughly open and ready to release their seed. When all the seed have been extracted from the cones they should be put into a sack or some other container and all the wings rubbed off. Slash seed will release their wings very easily and after rubbing the wings off in the sack the seed should

be dropped from the bag to a lower level in a current of air to separate the seed from the wings, or they may be run through a screen. Seed that are treated in this manner are clean and easily handled and should be stored in jars or other close containers until time to plant.

Preparing the Seedbed

Seedbeds should be located as near the planting site as practical. A supply of water near at hand is necessary as frequent watering during dry periods is desirable. Any sandy loam soil is suitable and can be prepared by spading up for at least a depth of ten inches, removing all weeds, sticks and grass. Beds should be slightly raised above the ground surface. This may be attained by building a frame four feet wide and sixteen feet long and 16 inches deep, setting the frame six inches in the ground as a protection against moles and mice. The width of the bed is made four feet to enable one to reach from one side to the other without having to stand in the bed. Raising the bed will insure the proper drainage.

Planting the Seedbed

The soil in the seedbed should be allowed to settle at least two weeks before planting the seed. Not over forty slash pine seedlings are desired per square foot of seedbed, but since only about 60 per cent of the seed planted germinate, a pound of seed may be planted in a bed 4 feet by 16 feet and the seedlings thinned out with only the healthy ones allowed to remain. This will assure the owner of real healthy, vigorous seedlings. The seed should be covered to a depth not to exceed one-fourth inch and not less than one-eighth. In South Georgia, seed beds may be planted from February 1 until March 1, although some have had success planting them in the fall.

Covering the Seedbed

Immediately after covering the seed to the required depth as stated above, the next step is to cover the seedbed with about 1 inch of clean pine straw, wetting it down with a fine sieved

sprinkler. Do not pour the water on with a bucket or hose. Watering should be continued for every other day if it is dry and no rains occur. At the end of eight or ten days the pine needle covering should be removed. There should be about forty seedlings per square foot. If the weather is very cool after planting the seed, it will take a little longer for them to sprout.

PROTECTING AND WEEDING

The seedbed should be protected from birds by screening the top of the bed. The greatest losses occur when birds pick the seed coating off of the top of the little seedling thus uprooting the whole plant. Losses have been as high as 75 per cent from this one source.

As soon as the covering is removed from the seedbed, all weeds should be pulled out so as to allow the seedlings to grow without competition. Weeding should be continued frequently until the seedlings are about 9 weeks old and then occasional weeding will be sufficient. Frequent watering is necessary, as stated above, until the seedlings get about 6 weeks old, then once a week is enough unless it rains on an average of once or twice a week. Shading is generally not necessary but can be resorted to in cases of extreme hot, sunny weather, as the seedlings are very tender and will scald easily if subjected to too much sunlight. If a seedbed is free of disease at the outset, it may be used three or four years without diseases appearing. If there is any danger of disease, one of the disinfectants used for plant beds may be employed.

LIFTING, PUDDLING AND HEELING-IN

Seed planted in February and March will be ready to transplant to the desired location in November. In lifting the seedlings, the bed should be wet thoroughly and then the little trees may be lifted out or loosened with a garden fork. They should be "puddled" immediately in a tub and moved to the planting site, care being taken that the roots do not dry out. "Puddling" was described in a former paragraph. Sometimes heeling-in overnight is necessary in a planting operation. In heeling-in, a

shallow trench is dug in moist or damp soil, the roots of the seedlings placed in the trench and covered and the ground packed down firmly around the roots. Be sure and never heel-in in a ditch containing water.

Bundling and packing will not be discussed as homegrown nursery stock will never have to be moved over a few miles to the planting site and bundling and packing will be unnecessary.

WHEN TO PLANT SEEDLINGS

When to plant, as discussed here, will deal with the time of year best suited for planting the seedlings, taking into consideration, of course, the weather conditions and the moisture content of the soil. Seedlings that have been successfully planted in several of the South Georgia counties were planted in late November and early December as the amount of moisture in the soil and all other conditions are just right at this time. Planting in the late fall and early winter gives the young trees time to adjust their roots and to become settled before growth begins in the spring. Avoid late spring plantings after growth has started and the soil has dried out. The spring winds tend to shake the young plants about, allowing the air to get to the roots which dries them and causes the seedlings to die. Never make a planting when the soil is so dry that watering is necessary to pack the soil around the roots. In South Georgia freezing of the soil is not a common occurrence and is not an important factor to consider.

HOW TO PLANT

The first thing to consider is spacing and the number of trees per acre. Determining factors are: (1) Character of trees desired, and (2) Products sought. The different spacings and number of trees per acre each spacing will require are as follows:

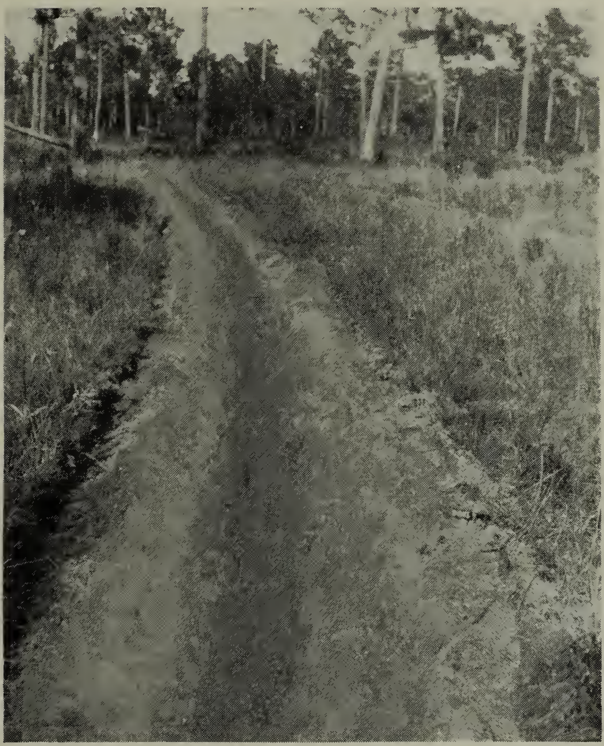
6 x 6 feet, 1,210 trees; 7 x 7 feet, 889 trees; 8 x 8 feet, 680 trees; 7 x 9 feet, 692 trees; 9 x 9 feet, 538 trees; 10 x 10 feet, 436 trees; 10 x 12 feet, 363 trees; 10 x 14 feet, 312 trees, 14 x 14 feet, 223 trees.

Laying off Planting Rows

For poles and piling, fence posts and cordwood, the 6 by 6 and 7 by 7 feet spacings are desired. For lumber, poles and crossties, 8 by 8 and 7 by 9 feet spacings should give good results. The 9 by 9 and 10 by 10 feet spacings are desirable for turpentine timber, cordwood and, finally, lumber; while all the other wider spacings are desirable for turpentine timber only as they will never grow to a straight, clean bole suitable for lumber. It is very important to determine as near as possible the products sought before planting. Closer spacings will give a little slower rate of diameter growth but will grow into tall, clean timber eventually, while the very wide spacings with a few trees per acre will give rapid diameter growth and be short boled with heavy crowns.

Preparation of Soil and Planting

All bushes and tall weeds should be removed from the area where the cost is not too great. If planting is to be made on ground fairly free from vegetation the following planting meth-



The Prepared Planting Bed

od is most efficient and economical where large scale planting is to be done: An efficient planting crew should consist of ten men. One foreman should have charge of the work. One man with a one-horse, three-inch scooter plow should lay off the rows. Two men should list the first furrow with one-horse turning plows, making a flat bed. They should not cover the first furrow completely as a depression in the bed is desirable. Two men should make planting holes with dibbles (wooden dibbles made of oak are good) or mattocks. One boy or man can drop plants and three men should follow immediately behind to set seedlings and firm the soil around them. It is very important that the planting crew keep together and set the seedlings before the roots can dry out.

Setting the One-Year-Old Seedling in the Field

Seedlings should be planted to the same depth that they stood in the seedbed, or from one-half inch to one inch deeper would be even better. The roots should fit easily into the planting hole and not be cramped. The soil should be thoroughly firmed around the roots and stem and finally packed by stepping on the soil at each side of the plant. This will assure a firmly set tree. The crew will plant on an average of from 15 to 20 acres per day on a spacing not closer than 7 by 9 feet.

Planting as outlined has given good results. Over one and a half million trees were successfully planted by this system on two plantations in one county. The advantages of this method are: (1). A prepared bed which helps to keep the weeds and grass from choking out the plants the first year, (2). The two furrows on each side of the plant act as water furrows to conserve moisture during dry periods and prevent covering of young

plants by sand-wash during hard rains, (3). Plowing acts as a secondary fire-break in protecting the trees from injury from accidental fire.

Planting seedlings by using the "Speedy Planting Spade" is practical on such areas as: (1) Pasture lands not easily plowed; (2) Open spaces in a stand of timber where quick regeneration is desired; (3) On all other areas where the cost of clearing the vegetation is prohibitive.

Spacing need not be regular and, in most cases, is not where the planting spade is used. A two-man crew is sufficient where spade planting is practiced, one man making the hole with the spade and the other inserting the plant and holding it upright while the man with the spade firms the soil around the roots and packs it with the heel of his foot, making sure that the tree is left standing straight with the soil packed down tight. The spade system of planting is desirable where small areas are to be planted and should give at least a 75 per cent stand.

COST OF PLANTING

Several factors will have to be considered before figuring the cost of planting for all of South Georgia as conditions in each locality are not the same. The cost of securing seedlings may be based upon the following and varies as to source of planting stock, whether home-grown, state nursery or wild stock. If wild stock can be found in sufficient numbers the cost per thousand will be practically the same as purchased stock, or $2.50 per thousand. The actual planting costs after seedlings are secured will depend upon the following:

(1) The amount of preparatory work necessary in removing bushes and weeds before the actual work starts; (2) the local prices paid for labor; (3) the spacing desired. It will cost more for the closer spacings in that more seedlings are used and it, of course, takes more time to plant them.

The costs for the complete planting operation, including seedlings cost, for the different spacings will be about as follows:

6 by 6 feet	1210 trees per acre	$4.50
7 by 7 "	889 " " "	4.15
8 by 8 "	680 " " "	3.70
7 by 9 "	692 " " "	3.70
9 by 9 "	538 " " "	3.75
10 by 10 "	436 " " "	3.75

All other spacings with fewer trees per acre will run from $2.25 to $3.25 per acre.

The foregoing figures will hold good as an average for South Georgia but in some localities the cost may run a little higher or a little lower than the costs for each spacing listed.

Care of the Young Plantation

If adequate protection from fire is not assured, it is a waste of time and money to plant trees and should not be undertaken. Fire-breaks should be plowed (solid plowing) through the plantation every two years. No cultivation of the plantation is necessary but horses and cows should not be allowed to graze on the area for at least two years as they will trample the young plants down. No watering of the young trees is necessary. Goats should be kept off until the trees get at least six years old as they bite the buds from young seedlings. After the trees get five or six years old, any kind of live stock may range on the land without material damage to the young trees, but remember to keep fire out at all times.

Expected Returns

A plantation of slash pine that is protected from all the harmful agencies described and allowed to grow, receiving the required treatment as to thinning and growing conditions, should begin to yield a revenue in cordwood, posts and some naval stores products within twelve or fifteen years after planting. Of course, trees planted at the closer spacings will require longer to get large enough to return a direct revenue, but as an average some product may be harvested from the plantation after it has reached the age of ten to twelve years, and if there is a market for pulpwood, the plantation could begin producing a revenue even sooner.

83